MEMOIRS OF THE Royal Society;

Or, a New ABRIDGMENT of the

Philosophical Transactions.

Giving an ACCOUNT of the Undertakings, Studies, and Labours of the LEARNED and INGENIOUS in many considerable Parts of the World; from the first Institution of that ILLUSTRIOUS SOCIETY in 1665, to 1740.

In the Course of this WORK, every Thing is carefully extracted from the ORIGINALS, according to the Order of Time; the LATIN TRACTS Englished; the Terms of ART explained; the Theoretical PARTS applied to Practice; and the whole Illustrated with a great Number of COPPER PLATES.

A PERFORMANCE of general Use for the Knowledge and Improvement of MATHEMATICKS, NATURAL PHILOSOPHY, TRADES, MANUFACTURES, ARTS, &c.

By Mr. BADDAM.

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MEMOIRS

OF THE

ROYAL SOCIETY;

Being a New ABRIDGMENT of the

PHILOSOPHICAL TRANSACTIONS:

Experiments on the Indian *Magnetic Sand; by M.* Muſchenbroek. Philoſophical Tranſactions N° 432. p. 297.

THE *Indian* ſand, which is brought to *Holland*, is ſaid to be chiefly gather'd upon the ſea-ſhore in *Perſia*; after which it is boil'd in water, to free it of its ſaltneſs; and after this it becomes a black powder, conſiſting of grains of different bigneſs; ſome of which have a very rough ſurface, and others one part of their ſurface ſomething rough, and the other very ſhining: Their figure is very irregular, like grains of common ſand; only this *Indian* ſand is ſmaller. Theſe little lumps have neither taſte nor ſmell, and are friable; ſo as to be eaſily reduced to a very ſubtile powder. It has ſome parts, which are ſtrongly attracted by the loadſtone; and others ſo very unactive, as ſcarcely to ſeem to be magnetical: The blackeſt are the ſtrongeſt, but the unactive ones are more ſhining, and inclining to the colour of lead; theſe are in the greateſt quantity; and from them the others are got out by a loadſtone. The ingenious *Montenus* has ſeveral ways examin'd ſuch a kind of ſand, which is brought from *Virginia*,

and described it in *Phil. Transf.* N° 197. M. *Muschenbroek* examin'd the *Indian* sand another way; of which he gave an account in his *Physical Dissertations*, p. 127. But a great deal still remain'd to be considered; and as there is a great deal more of this substance of the lazy or unactive than of the active or magnetic sort; it was proper to try, whether a magnetic virtue might not be excited or increas'd in all of it; and after a few trials he found the thing succeed. He suspected that there might perhaps be too great a quantity of sulphur adhering to the sand, to suffer it to be turned into any metalline *regulus* by a long continuance in the fire; he therefore, toasted it in an open crucible for two hours with half the quantity of pot-ash; he afterwards wash'd away the salt with water, and the sand remain'd much blacker than before, of which he found more than a quarter endued with a greater magnetic force. M. *Muschenbroek* does not scruple to attribute this virtue to the salt; because tho' the action of the fire alone does increase the force of the sand; yet it does not give it near so much attractive force.

And because common black soap is made of oil boil'd with a *lixivium* of pot-ash, he had a mind to try whether soap might not do more than salt alone in exciting the virtue in the sand: So he mix'd the sand with an equal quantity of soap, which he first exposed to a gentle fire in an open crucible, to dry up the soap which swells very much; then the fire was heightened for ¾ of an hour, the oily substance entirely consumed, and the matter in the crucible strongly fir'd: Then afterwards boiling it in water, and washing it well, he obtain'd a black sand, which was all endu'd with a vigorous attracting force. Pleas'd with this success, he had a mind to try whether he could excite a greater force in it: Wherefore he again roasted it with black soap as before, and even a third time; but no addition was thereby made to its virtue. He found that keeping it too long in the fire is as prejudicial as keeping it too short a time; between half an hour and an hour seem'd to him the most proper space of time.

He afterwards added to the black soap half the quantity of salt of tartar, mixing therewith an equal quantity of sand; which, when expos'd in a crucible to a reverberatory fire for ¾ of an hour, he wash'd in water; and then so considerable was the virtue of the sand, that if it did not exceed the former, it at least was equal to it.

And

And becauſe he had obſerv'd the oilineſs of the ſoap to conduce much to excite the virtue in the ſand; he mixt beef-tallow with an equal quantity of ſand, and having cloſed the crucible very well, he expos'd the whole maſs to a reverberatory fire for two hours; whereby the ſand became much blacker, and receiv'd a great deal of attractive virtue: But that ſand, which was burned two hours with an equal quantity of pitch, became more active, as alſo very black, ſubtile, and very little ſhining: But when it was expos'd a longer time in the ſame crucible, he obſerv'd it to be weaker; as alſo when it was in the crucible with the pitch, but $\frac{1}{8}$ of an hour, it ſcarce acquir'd any virtue: So that there muſt be a determined action of fire to raiſe the virtue in the ſand. Yet he could not excite a greater virtue in the ſand than by the following means; *viz.* mixing the ſand in the crucible with equal parts of roſin, pitch, frankincenſe, and rape-oil, and expoſing it to a reverberatory fire for an hour, having firſt clos'd up the crucible well. Between the black coals of the oily matter, there ſticks a very black ſand, which leaps up ſwiftly to the loadſtone, as ſoon as it is brought near it. Then he conſidered whether the ſand did not acquire the greateſt force, as it came nearer to the nature of ſteel, by burning it with the above-mentioned bodies; and ſuſpecting this, in order to try it, he put it among ſuch bodies as turn iron into ſteel, according to the operations deſcrib'd by that great Experimenter M. *Reaumur*, in that excellent book, entituled, *The Art of turning Iron into Steel.* He, therefore, took three parts of ſand, two parts of chimney ſoot, and of ſea-ſalt, powder'd charcoal, and aſhes, one part each. Having accurately mixed all theſe bodies together, they were expos'd for ſix hours in a cloſe crucible to a ſtrong fire; and then the whole maſs was boil'd and waſh'd in water, then dried, and ſo receiv'd a great deal of attracting force: but it was not near ſo active as that prepar'd with ſoap, or in the manner laſt deſcribed.

M. *Muſchenbroek* conjectured at firſt, that this ſand is an imperfect magnet, or ſubtile powder of it, which, when it is grown up into a greater lump, forms the common loadſtones: But when he found by experience that common loadſtones expos'd to the fire, according to ſome of the methods above-mentioned, did rather loſe of their force than gain, he alter'd his opinion, and owns that he has not hitherto penetrated into the knowledge of this matter.

What-

Whatever it be, it is certain that there are ſeveral kinds of this ſand, brought from different countries of the earth: For, it is brought from *Perſia*; and ſome from *Virginia*: There is another ſort in *Italy*, common enough at *Leghorn*: And this laſt is naturally very attractive: There are two ſorts found in the *Eber*, a river of *Haſſia*; of which one reſembles the *Italian*, and the other conſiſts of large grains, almoſt as big as hemp-ſeed, but ſcarce having any virtue.

M. *Muſchenbroek* had, beſides, a very vigorous ſort, which he is told was got near old *Raguſa* in *Dalmatia*. The ſeveral kinds of this ſand are unknown, which time and the diligent obſervations of philoſophers muſt hereafter ſhew.

Some Obſervations made in London; *by Mr.* George Graham; *and at* Black-river *in* Jamaica; *by Mr.* Colin Campbell, *about the going of a* Clock; *in order to determine the difference between the lengths of* Iſochronal Pendulums *in thoſe Places*; *and communicated by Mr.* Bradley. Phil. Tranſ. N° 432. p. 302.

THO' it be upwards of 60 years, ſince M. *Richer* firſt diſcover'd, that pendulum's of the ſame length do not perform their vibrations in equal times in different latitudes; and tho' ſeveral experiments, ſince made in different parts of the earth, concur to prove, that pendulum's ſwinging ſeconds are in general ſhorter as we approach the equator: Yet what the real difference is between their lengths in different latitudes, does not ſeem to have been determin'd with ſufficient exactneſs by the obſervations that have hitherto been communicated to the public; as may be gather'd from the 20th. propoſition of the third book of Sir *Iſaac Newton's Principia*, where they are compar'd as well with each other, as with the theory of that illuſtrious author. It were, therefore, to be wiſh'd that more of this kind of experiments could be made with greater accuracy in proper places, by ſuch perſons as have ſufficient ſkill and opportunities to do it; that we might thereby be enabled to judge with more certainty concerning the true figure of the earth, and the nature of its conſtituent parts.

As an inducement to ſuch as may have it in their power to put the like again into practice, here follows an account of a very curious experiment of this ſort, made in *Jamaica* by Mr. *Campbell*: His clock, which was made by the ingenious Mr. *Graham*, was ſo carefully contriv'd, that its pendulum might at pleaſure be reduced to the ſame length, whenever there ſhould

ſhould be occaſion to remove the clock from one place, and ſet it up in another.

This clock, being chiefly deſigned for aſtronomical obſervations, had no ſtriking part, and its pendulum was adjuſted to ſuch a length, that in *London* it vibrated ſeconds of ſidereal, and not ſolar, time. When it was finiſh'd, Mr. *Graham* fix'd it up in a room, ſituated backward from the ſtreet, and on the northſide of his houſe to prevent its being diſturbed by coaches, or other carriages that paſs'd thro' the ſtreets, and that it might be as little affected by the ſun as poſſible. Having ſet it going, he compared it with the tranſits of the ſtar *lucida aquilæ* over the meridian, which paſs'd

	Days		h	′	″	
Auguſt 1731	20th	at	8	59	15	by the clock.
	22	at	8	59	18	
	23	at	8	59	20 ½	
	25	at	8	59	22	
	28	at	8	59	25 ½	
	29	at	8	59	26	
	30	at	8	59	27	

Hence it appears that the clock gained 12 ſeconds in 10 apparent revolutions of the ſtar.

In order to eſtimate how much the pendulum may be lengthened by greater degrees of heat, or how much ſlower the clock would go on that account, when remov'd into a warmer climate, a thermometer was fixed by the ſide of it; and between the hours of 10 and 11 o'clock in the morning, and at night, notice was taken at what height the ſpirits ſtood, and the mean height for each day was as follows.

	Days	Therm.	
Auguſt 1731	21	32 ½	Diviſions.
	22	30 ¾	
	23	28 ¾	
	24	27 ¾	
	25	28 ¼	
	26	27 ¼	
	27	27 ½	
	28	27 ½	
	29	27 ½	
	30	27 ¾	

Hence

Hence the mean height for all these days was about $28\frac{1}{2}$ divisions.

The clock-weight, that keeps the pendulum in motion, is 12 *lb.* $10\frac{1}{2}$ *oz.* and is to be wound up once a month. The weight of the pendulum itself is 17 pounds; and (during the time that the clock was compar'd with the transits of the star) it vibrated each way from the perpendicular $1^\circ\ 45'$. The magnitude of the vibrations was estimated by means of a brass arch, which was fixed just under the lower end of the rod of the pendulum, and divided into degrees, &c.

August 31, Mr. *Graham* took off the weight belonging to the clock, and hung on another of 6 *lb.* 3 *oz.* and with this weight the pendulum vibrated only $1^\circ\ 15'$ on each side; and the clock went 1 second and $\frac{1}{2}$ slower in 24 hours, than when its own weight of 12 *lb.* $10\frac{1}{2}$ *oz.* was hung on.

This experiment shews that a small difference in the arcs, described by the pendulum, or a small alteration in the weight that keeps it in motion, will cause no great difference in the duration of the vibrations; and therefore a little alteration in the tenacity of the oil upon the pivots, or in the foulness of the clock, will not cause it to accelerate, or retard its motion sensibly: From whence we may conclude, that whatever difference there shall appear to be, between the going of the clock at *London* and in *Jamaica*, it must be entirely owing to the lengthning of the pendulum by heat, and the diminution of the force of gravity upon it.

Mr. *Graham* sent very full directions to Mr. *Campbell*, describing in what manner the clock was to be fixed up, and how the pendulum might be reduced exactly to the same state as it was when in *England*; but no intimation was given concerning the going of the clock, that the experiment might be made with all possible care, and without any byass or prejudice in favour of any hypothesis, or former observations.

In *July* 1732 we receiv'd an account of the success of the experiment by the hands of Mr. *Joseph Harris*, who was present at the making of it in *Jamaica*; and who brought over with him the original journal of the observations of the transits of 2 stars, (*viz. Sirius* and *β Canis majoris*) over the meridian, compared with the clock, after it was fixed up in *Jamaica*, as Mr. *Graham* had directed; together with the height of the spirits of the aforesaid thermometer, on the several days of observation.

The

The chief of those observations are contain'd in the following table; the first column shews the day of the month; the second the name of the star, and the time by the clock of its observed transit over the meridian; the third contains the hour of the day, when the thermometer was observ'd, together with the height of the spirits at those hours; the morning hours being denoted by the letter A, and those of the afternoon by the letter P.

1732	Canis Majoris.	Time of Transit.	Hour of Day.	Thermometer.
Jan.		h ′ ″	h	
23	β	11 59 50	10½A	14¾
	α	12 22 14	9½P	11
24		Cloudy.	11½A	15¼
25	β	11 55 40	8½A	17½
	α	12 18 4	9¼P	11¼
26	β	11 53 35	8 A	20
	α	12 16 00	2 P	8½
			9 P	10
27	β	11 51 31	7 A	17½
	α	12 13 55	2 P	8½
			9¾P	12½
28	β	11 49 26	7 A	20½
	α	12 11 51	2 P	11
			10 P	12
29	β	11 47 22	6¾A	19
	α	12 9 46	3 P	9
			9 P	11¼
30		Cloudy.	7 A	20½
			4 P	7
			11 P	13
31	β	11 43 12	7 A	20
	α	12 5 37	9 P	8½
Feb. 1	β	11 41 8½	10 A	18¾
	α	12 3 33	11 P	16
Feb. 2	β	11 39 0	9½A	17½
		12 1 23½	2 P	9
	α		5 P	6
			9 P	8½
3	β	11 36 53	8½A	19
			1 P	9½
			9 P	9
4	β	11 34 46	6¼A	18
	α	11 57 11	12	9½
			9 P	8
5	β	11 32 40	7½A	19¼
	α	11 55 5	3½P	6
			8½P	8
6	β	11 30 35	7 A	18½
	α	Cloudy.	4 P	7½
			8½P	8
7	β	11 28 31	7 A	20½
	α	11 50 55	12	12
			8½ P	8½
8	β	Cloudy.	6½A	21½
	α	11 48 50	8½P	8¼
9	β	11 24 20	9½A	14
	α	11 46 44	8½P	8
10	β	11 22 12½	7¼A	16
	α	11 44 37	11½A	10
			3¾P	3¾
			8½P	6

Canis

1732	Canis Majoris.	Time of Transit.	Hour of Day.	Thermometer.
Feb.	β	11 20 6	7½ A	16
11	α	11 42 30	12	9½
			8½ P	5¾
12	β	11 18 0	10 A	17½
	α	11 40 24	12	13
			8 P	5¾
13		Clouds.	9 A	17
			8 P	6
14	β	Cloudy.	7½ A	16
	α	11 36 15	12	11
			8 P	10
15		Clouds.	9 A	18
			12	13¾
			8½ P	7½

1732	Canis Majoris.	Time of Transit.	Hour of Day.	Thermometer.
Feb.	β	Cloudy.	8 A	14
16	α	11 32 4	8 P	7
17	β	11 7 34	12	12
	α	11 29 59	8 P	6¼
18	β	11 5 29	12	12¼
	α	11 27 53		

The pendulum, during this interval, vibrated about 1° 52′ each way from the perpendicular.

The tranſits of the ſtars over the meridian were obſerved with a teleſcope, fixt at right angles to an horizontal axis, whoſe ends lay exactly eaſt and weſt; by the turning of which axis, the line of collimation of the teleſcope was conſtantly directed in the plane of the meridian. This inſtrument was daily adjuſted to a mark, fixt in the meridian; and in the journal, between the ſecond and third of *February*, the following remark was made.

N. B. This day was hotter than uſual, as appears by the thermometer; and the tranſit inſtrument had loſt the level a little; but after we had adjuſted it, it pointed exactly to our meridian mark; and therefore we are at a loſs for the cauſe of this difference in the clock.

From the foregoing table it appears, that the clock loſt 54′ 21″ in 26 revolutions of the ſtars; that is, about 2′ 5″ and ½ in one revolution; the difference from this medium ſomewhat varying upon account of a greater or leſs degree of heat on different days.

The mean of all the obſerved heights of the thermometer from *Jan.* 26, to *Feb.* 18, was about 12 diviſions and ½: Therefore, the difference between the mean heights of the thermometer at *Jamaica* and *London*, during the intervals of the reſpective obſervations, was 15 diviſions and ½; the ſpirit

ſtand-

ſtanding ſo much higher in *Jamaica*, becauſe of the greater heat in that iſland.

That we might be able to judge, how much the different degrees of heat, correſponding to any number of diviſions upon this thermometer would cauſe the clock to go ſlower, by lengthening its pendulum, Mr. *Graham* took notice of the loweſt point, to which the ſpirits ſunk at *London* in the winter 1731, and the greateſt height, to which they roſe in the following ſummer; and comparing the motion of the ſpirits in this thermometer, with the alterations in another made with quickſilver, which he had for ſome years made uſe of; he concluded that at *London* the ſpirits in this thermometer would ſtand (one year with another) about 60 diviſions higher in ſummer than in winter.

By ſeveral years experience he likewiſe found, that his clocks (of the ſame ſort with Mr. *Campbell*'s) when expos'd, as uſual, to the different degrees of heat and cold of our climate, do not vary in their motion above 25 or 30 ſeconds in a day.

From theſe obſervations and experiments we may, therefore, reaſonably conclude, that ſufficient allowance will be made for the lengthening of the pendulum by heat, if we ſuppoſe the clock upon that account to go one ſecond in a day ſlower, when the ſpirits of this thermometer ſtand two diviſions higher, and in the ſame proportion for other heights.

Admitting then that the mean height of the thermometer, while the clock was compar'd with the ſtars at *Jamaica*, exceeded that at *London* between 15 and 20 diviſions; if we allow eight or nine ſeconds, upon that account, the remaining difference muſt be entirely owing to the difference of the force of gravity in the two places.

Upon comparing the obſervations, it appears, that in one apparent revolution of the ſtars, the clock went 2′ 6″ and ½ ſlower in *Jamaica* than at *London*; deducting, therefore, 8″ and ½, on account of the greater heat in *Jamaica*, there remains a difference of 1′ 58″, which muſt neceſſarily ariſe from the diminution of gravity, in the place neareſt the equator.

Mr. *Bradley* has allow'd the clock to have loſt ſomewhat more on account of the difference of heat than the mean heights of the thermometer may ſeem to require, upon a ſuppoſition, that the total heat of the days, compared with the cold of the nights, bears a greater proportion in *Jamaica*

than *London*; but if that supposition be not admitted; then the clock in *Jamaica* must have gone rather more than 1′ 58″ in a day slower than in *England*.

Mr. *Campbell*'s observations were made at *Black-river* in 18° N. Lat. Now if we suppose with Sir *Isaac Newton*, that the difference in the going of the clock is owing to the greater elevation of the parts of the earth towards the equator, it will follow from these observations, and what is deliver'd by him in Prop. 20. of the third book of his *Principia*, that the equatorial diameter is to the polar as 190 to 189; the difference between them being 41 miles and $\frac{1}{2}$; which is somewhat greater than what Sir *Isaac Newton* had computed from his theory, upon the supposition of an uniform density in all the parts of the earth.

Without entering into the dispute about the figure of the earth, Mr. *Bradley* at present supposes with Sir *Isaac Newton*, that the increase of gravity, as we recede from the equator, is nearly as the square of the sine of the latitude, and that the difference in the length of pendulums is proportional to the augmentation or diminution of gravity. Upon these suppositions Mr. *Bradley* collects from the above-mentioned observations, that if the length of a simple pendulum (that swings seconds at *London*, be 39.126 *English* inches, the length of one at the equator would be 39.00, and at the poles 39.206. And (abstracting from the alteration on account of different degrees of heat) a pendulum clock, that would go true time under the equator, will gain 3′ 48″ and $\frac{1}{4}$ in a day at the poles: But the number of seconds, which it would gain in any other latitude, would be to 3′ 48″ and $\frac{1}{4}$ nearly, as the square of the sine of that latitude, to the square of the radius: Whence it follows, that the number of seconds a clock will lose in a day, upon its removal to a place nearer the equator, will be to 3′ 48″ and $\frac{1}{4}$ nearly, as the difference between the squares of the sines of the latitudes of the two places, to the square of the radius. Thus the difference of the squares of the sines of 51° and $\frac{1}{2}$ and 18°, the latitudes of *London* and *Black-river*, being to the square of the radius, as 118 to 228 and $\frac{1}{4}$, the clock will go 1′ 58″ in a day slower at *Black-river* than at *London*, as was found by observation.

It may be hoped, that Mr. *Campbell*'s success in this experiment, and the little trouble there is in making it, will induce those gentlemen who may hereafter carry pendulum clocks

clocks into diſtant countries, to attempt a repetition of it after his manner; that is, by keeping or reſtoring the pendulum's of their clocks to the ſame length in the different places, and carefully comparing them with the heavens; and at the ſame time taking notice of the different degrees of heat, by means of a thermometer. From a variety of ſuch experiments we ſhould be enabled to determine how far Sir *Iſaac Newton*'s theory is conformable to truth, with much greater certainty than from thoſe trials which are made by actually meaſuring the lengths of ſimple pendulum's; becauſe a difference of one hundredth part of an inch, in the length of a pendulum, correſponds to 11 ſeconds in a day: And it being eaſy to obſerve how much a clock gains or loſes in a day, even to a ſingle ſecond. It is certain, that by means of a clock, compared in the manner abovementioned, we may diſtinguiſh a difference (in the lengths of iſochronal pendulum's) of one thouſandth part of an inch or leſs; whereas it will be ſcarce poſſible to meaſure their true lengths, without being liable to a greater error than that. Beſides, by taking notice how much a clock gains or loſes, upon the falling or riſing of a thermometer, we can better allow for the different degrees of heat in this, than in the other method of making the experiment, by actual meaſurement; ſince it may not be eaſy to determine how much the meaſure itſelf, which we make uſe of, will be lengthened by different degrees of heat.

For theſe reaſons Mr. *Bradley* reckons Mr. *Campbell*'s experiment to be the moſt accurate of all that have hitherto been made, and propereſt to determine the difference of the gravity of bodies in different latitudes; and therefore he ſubjoins a table he computed from it, that contains the difference of the length of a ſimple pendulum, ſwinging ſeconds at the equator, and at every fifth degree of latitude, together with the number of ſeconds that a clock would gain in a day, in thoſe ſeveral latitudes, ſuppoſing it went true when under the equator; by means of which any one may readily compare other the like obſervations with his; and thereby diſcover whether the alteration of gravity in all places be uniform, and agreeable to the rule laid down by Sir *Iſaac Newton* or not.

The

The Lat. of the Place.	The difference of the length of the pendulum in parts of an *English* inch,	Seconds gained by a clock in 1 day.	The Lat. of the place.	The difference of the length of the pendulum in parts of an *English* inch.	Seconds gained by a clock in 1 day.
Deg.	Inch.	Seconds	Deg.	Inch.	Seconds
5	0.0016	1.7	50	0.1212	134.0
10	0.0062	6.9	55	0.1386	153.2
15	0.0138	15.3	60	0.1549	171.2
20	0.0246	26.7	65	0.1696	187.5
25	0.0369	40.8	70	0.1824	201.6
30	0.0516	57.1	75	0.1927	213.0
35	0.0679	75.1	80	0.2003	221.4
40	0.0853	94.3	85	0.2050	226.5
45	0.1033	114.1	90	0.2065	228.3

Conjectures on the charming or fascinating Power of the Rattle-snake, *grounded on credible Accounts, Experiments and Observations; by Sir* Hans Sloane. Phil. Trans. N° 433. p. 321.

AS to rattle-snakes, it is universally agreed on, that by keeping their eyes fixed on any small animal, as a squirrel, bird or the like, tho' sitting on the branch of a tree at a considerable height, it shall, by such stedfast or earnest looking thereon, be made to fall dead into their mouths.

Sir *Hans* had a rattle-snake given him, which had been sent alive in a box with some gravel from *Virginia*; it had liv'd three months without any sustenance and had in that time cast its outer coat or *exuviæ*, which was found amongst the gravel.

Captain *Hall*, a very understanding and observant person, who had liv'd several years in *Virginia*, ventur'd to take the snake out of the box; notwithstanding that the poison from its bite is almost present death: For, he gave an instance of a person bitten, who was found dead at the return of a messenger going to the next house to fetch a remedy, tho' he was not gone above half an hour: Nay, so certain are the mortal effects of this poison, that sometimes the waiting till an iron can be heated, in order to burn the wound, is said to have prov'd fatal: He therefore thought the safest way was immediately to cut out the part where the wound was made:

For,

For, he had ſeen ſeveral, who carried theſe hollow ſcars about them, as marks of the narrow eſcape they had had, and they never felt any inconvenience afterwards.

Tho' providence hath produced a creature ſo terrible to other animals; yet it ſeems to have provided it with the rattle at its tail, that the noiſe thereof may give them warning to get out of its way.

An experiment was tried before ſeveral phyſicians in the garden belonging to the College in *London*: The Captain, by keeping the head faſt with a forked ſtick, and making a nooſe, which he put about the tail of the ſnake, tied it faſt to the end of another ſtick, with which he took the ſnake out and laid him upon the graſs-plat. Then a dog being made to tread upon him, he bit the dog, who thereupon howl'd very bitterly, and went away ſome few yards from the ſnake: But in about a minute of time he grew paralytic in the hinder legs, as dogs do who have the *aorta deſcendens* tied: He died in leſs than three minutes, as is related by Mr. *Ranby* in an account of this experiment in Phil. Tranſ. N° 401. p. 377. and by Captain *Hall* N° 399. p. 309.

According to Sir *Hans*, the whole myſtery of their inchanting or charming any creature, is chiefly this, namely, that when ſuch animals as are their proper prey, as ſmall quadrupeds, and birds, *&c.* are ſurpriſed by them, they bite them, and the poiſon allows them time to run a ſmall way, as the dog in the above experiment did; or perhaps a bird to fly up into the next tree, where the ſnakes watch them with great earneſtneſs, till they fall down, or are perfectly dead, when having lick'd them over with their ſpawl or ſpittle, they ſwallow them down, as the following accounts relate.

'Some people in *England* (*ſays Colonel* Beverly *in his Hiſtory of* Virginia Edit. 2d. p. 260. Lond. 1722. 8vo.) are 'ſtartled at the very name of the rattle-ſnake, and fancy 'every corner of that province ſo much peſter'd with them, 'that a man goes in conſtant danger of his life, that walks 'abroad in the woods, But this is a groſs miſtake: For, 'firſt, this ſnake is very rarely ſeen, and when that happens, 'it never does the leaſt miſchief, unleſs you offer to diſturb 'it, and thereby provoke it to bite in its own defence: And 'it never fails to give you fair warning by making a noiſe 'with its rattle, which may be heard at a convenient diſtance. 'For my own part, I have travell'd the country as much as

'any

'any man; and yet before the first impression of this book, I had never seen a rattle-snake alive and at liberty in all my life. The bite of this viper, without some immediate application, is certain death: But remedies are so well known, that none of their servants are ignorant of them. I never knew any one kill'd by these or any other of their snakes. They have several other snakes, which are seen more frequently, and have very little or no hurt in them; such as the black-snakes, water-snakes and corn-snakes. The black viper-snake, and the copper-bellied snake, are said to be as venemous as the rattle snake; but they are as seldom seen. These three poisonous snakes bring forth their young alive; whereas the other three sorts lay eggs, which are afterwards hatch'd; and that is the distinction they make, esteeming those only to be venemous, which are viviparous. They have likewise the horn-snake, so call'd from a sharp horn it carries in its tail, with which it assaults any thing that offends it, with such force, that, as it is said, it will strike its tail into the but-end of a musket, from which it is not able to disengage itself.

'All sorts of snakes will charm both birds and squirrels; and the *Indians* pretend to charm them. Several persons have seen squirrels run down a tree directly into a snake's mouth: They have likewise seen birds fluttering up and down, and chattering at these snakes, till at last they have dropt down before them.

'In the latter end of *May*, 1715, stopping at an orchard, by the road side (being three of us in company) we were entertain'd with the whole process of a charm between a rattle-snake and a hare; the hare being better than half grown. It happened thus; One of the company, in his search for the best cherries, espied the hare sitting, and tho' he went close by her, she did not move; till he (not suspecting the occasion of her tameness) gave her a lash with his whip. This made her run about ten foot, and there sit down again. The Gentleman not finding the cherries ripe, immediately return'd the same way; and near the place where he struck the hare, he espied a rattle-snake. And still not suspecting the charm, he goes back about 20 yards to a hedge to get a stick to kill the snake; and at his return found the snake remov'd and coil'd in the same place, from whence he had mov'd the hare. This put him into the thoughts of looking for the hare again, and

'and he soon spied her about 10 foot off the snake, in the 'same place to which she had started when he whipt her. 'She was now lying down; but she would sometimes raise 'herself on her fore-feet, struggling as it were for life, or to get 'away, but could never raise her hinder parts from the 'ground; and then she would fall flat on her side again, 'panting vehemently. In this condition the hare and snake 'were when he call'd me; and tho' we all three came up 'within 15 foot of the snake, to have a full view of the 'whole, the snake took no notice at all of us, nor so much 'as gave a glance towards us. There we stood at least half 'an hour, the snake not altering a jot; but the hare often 'struggling and falling on its sides again, till at last the hare 'lay still for some time as dead. Then the snake mov'd out 'of his coil, and slid gently and smoothly on towards the 'hare, his colours at that instant being ten times more glo-'rious and shining than at other times. As the snake mov'd 'along, the hare happened to fetch another struggle, upon 'which the snake made a stop, lying at his length, till the 'hare had lain quiet again for a short space; and then he 'advanc'd again, till he came up to the hinder parts of the 'hare, which in all this operation had been towards the 'snake. There he surveyed the hare all over, raising part 'of his body above it, then he turned off, and went to the 'head and nose, after that to the ears; took the ears in his 'mouth one after the other, working each apart in his mouth, 'as a man does a wafer to moisten it; then return'd to the 'nose again, and took the face into his mouth, straining and 'gathering his lips, sometimes by one side of his mouth, 'sometimes by the other. At the shoulders he was a long 'time puzzled, often haling and stretching the hare out at 'length, and straining forward first one side of his mouth, 'then the other; till at last he got the whole body into his 'throat. Then we went to him, and taking the twist-band 'off from my hat, I made a noose, and put it about its 'neck. This made him at length very furious: But having 'secured him, we put him into one end of a wallet, and 'carried him on horseback five miles to the house where we 'lodged that night. Next morning we killed him and took 'the hare out of his belly. The head of the hare began to 'be digested, and the hair to fall off, having lain about 18 'hours in the snake's belly.

'In my youth I was a bear-hunting in the woods, above the 'inhabitants; and having ſtrayed from my companions, I was 'entertain'd upon my return with a relation of a pleaſant ren-'countre between a dog and a rattle-ſnake, about a ſquirrel. 'The ſnake had got the head and ſhoulders of the ſquirrel into 'his mouth, which being ſomething too large for his throat, it 'took him up ſome time to moiſten the furr of the ſquirrel 'with his ſpawl, to make it ſlip down. The dog took this 'advantage, ſeized the hinder parts of the ſquirrel, and tugged 'with all his might. The ſnake on the other ſide would not let 'go his hold for a long time; till at laſt, fearing he might be 'bruis'd by the dogs running away with him, he gave up his 'prey to the dog. The dog eat the ſquirrel and felt no harm.

'Another curioſity concerning this viper, I will relate from 'my own obſervation. A rattle-ſnake being taken in a nooſe, 'I cut off the head, leaving about an inch of the neck with it: 'This I laid upon the head of a tobacco hogſhead, one *Stephen* '*Lankford*, a carpenter, being with me. Now theſe ſnakes 'have but 2 teeth, by which they convey their poiſon, and 'theſe are placed in the upper jaw, pretty forward in the mouth, 'one on each ſide. Theſe teeth are hollow and crooked like a 'cock's ſpur: They are alſo looſe or ſpringing in the mouth, 'and not faſtened in the jaw-bone, as all the other teeth are. 'The hollow has alſo a vent thro' by a ſmall hole a little be-'low the point of the tooth. Theſe 2 teeth are kept lying 'down along the jaw, or ſhut like a ſpring knife: They have 'alſo over them a looſe thin film or ſkin of a fleſh colour, which 'riſes over them when they are rais'd. This ſkin does not 'break by the riſing of the tooth only, but keeps whole till the 'bite is given, and then it is pierced by the tooth, by which 'the poiſon is let out. The head being laid upon the hogs-'head, I took two little twigs or ſplinters of ſticks; and having 'turned the head upon its crown, open'd the mouth, and lifted 'up the fang or ſpringing tooth on one ſide ſeveral times; in 'doing of which I at laſt broke the ſkin. The head gave a 'ſudden champ with its mouth, breaking from my ſticks; in 'which I obſerved that the poiſon ran down in a lump like oil, 'round the root of the tooth. Then I turned the other ſide of 'the head, and reſolv'd to be more careful to keep the mouth 'open on the like occaſion, and obſerve more narrowly the con-'ſequence: For, it is to be obſerv'd, that tho' the heads of 'ſnakes, terrapins (*a ſort of tortoiſe*) and ſuch like vermin be 'cut off; yet the body will not die in a long time after, the

'general

'general ſaying is, not till the ſun ſets. After opening the 'mouth on the other ſide, and lifting up that fang alſo ſeveral 'times, he endeavour'd to give another bite or champ. But I 'kept his mouth open, and the tooth pierced the film, and 'emitted a ſtream like that in blood-letting, and caſt ſome drops 'upon the ſleeve of the carpenter's ſhirt, who had no waiſt-'coat on. I advis'd him to pull off his ſhirt, but he would 'not, and receiv'd no harm; and tho' nothing could then be 'ſeen of it upon the ſhirt; yet in waſhing there appear'd 5 'green ſpecks, which every waſhing appear'd plainer and 'plainer, and laſted as long as the ſhirt, which was about 3 'years after. The head we afterwards threw down upon the 'ground; and a ſow came and eat it before our faces, and re-'ceiv'd no harm. Now I believe, had this poiſon lighted upon 'any place of the carpenter's ſkin, that was ſcratch'd or hurt, it 'might have poiſon'd him. I take the poiſon to reſt in a ſmall 'bag or receptacle in the hollow at the root of theſe teeth; but 'I never had the opportunity afterwards to make a farther diſ-'covery of that.

'As to the violent effects of this poiſon I was told by Colonel '*James Taylor*, that being with others in the woods a ſurvey-'ing, they found a rattle-ſnake, and cut off his head, and about '3 inches of the body. Then with a green ſtick which he had 'in his hand, about a foot and a half long, the bark being 'newly peel'd off, he urged and provoked the head; till it bit 'the ſtick with fury ſeveral times. Upon this the Colonel ob-'ſerved ſmall green ſtreaks to riſe up along the ſtick towards 'his hand. He threw the ſtick upon the ground, and in a quar-'ter of an hour, the ſtick of its own accord ſplit into ſeveral 'pieces, and fell aſunder from end to end. This account I had 'from him again at the writing hereof.'

F. *La Bat* likewiſe tells us (in his *nouveau voyage aux iſles de l'Amerique* Tom. 4. p. 96, 106. *Edit. Paris*, 1722, 8°) that ſerpents, when they bite their prey, retire to avoid being hurt by them; and when dead, cover them with their ſpittle, extend their feet along their ſides and tails, if quadrupeds, and ſwallow them.

The Squilla aquæ dulcis; *by Dr.* Richardſon. Phil. Tranſ. N° 433. p. 331.

DR. *Richardſon* obſerv'd what he does not remember to be taken notice of by any naturaliſt; namely, the great de-ſtruction made amongſt the ſmall fry of fiſh by the *ſquilla*

aquæ dulcis, which abound in most standing waters. In a small breeding pond near his house, where he had formerly plenty of small carp and tench every year, but more latterly scarce any young fry to be met with, his gardener observed one of the *squillæ* with a carp in its mouth almost as big as itself; and he afterwards observed these insects hunting amongst the weeds, and vigorously pursuing the small fry. The Dr. order'd the gardener to catch some of these insects, and bring them home alive, with some of the smallest fish he could meet with. They were put together in a large bason of water; and the insects were so rapacious, that they fell upon the fish immediately, and destroy'd several in his sight; and before morning they devour'd all that were in the bason.

A solar Eclipse *observed at* Witemberg *a little before sun-set,* May 2. 1733, O. S. *by M.* Weidler. Phil. Transf. N° 433. p. 332. *Translated from the* Latin.

Phases of the immersion

	H.	'	S.
May 2, 1733, O. S. The beginning of the eclipse at — —	6	36	5 *p. m.*
1 digit eclipsed —		39	50
2 digits —		45	5
3 — —		48	50
4 — —		52	50
5 — —		58	5
6 — —	7	2	50
7 — —		7	50
8 — —		10	50
9 — —		15	50
10 — —		19	50
11 — —		29	20

The sun goes under thin clouds.

Phases of the emersion.

10 digits eclips'd	7	35	50
9 —		40	50
8 —		44	50
The sun sets at — —		46	5

M. *Weidler* makes the following remarks.

1. The

1. The circle (Fig. 1. Plate I.) repreſents the image of the ſun, as it appear'd in the bottom of the helioſcope.

2. The light of the ſun, near the moon's diſk, which M. *Weidler* had always obſerv'd, in other ſolar eclipſes, as well near the horizon, as under a greater altitude, to have a ſtrong undulatory motion, was quite ſtill and calm in this.

3. The moon's diſk, eſpecially on its weſtern part, in the phaſes obſerv'd a little before ſun-ſet, appear'd to all the beholders to have a manifeſt aſperity; yet there were ſpaces, neither very broad nor deep, by which the tops of the lunar mountains were diſtinguiſhed: And with a nicely divided ſcale he eſtimated the depth of one valley to be $\frac{1}{200}$ part of the moon's diameter.

4. The laſt phaſes of the emerſion were ſeen thro' thin clouds; and yet the moon did not cover above 11 dig. of the ſun's diſk.

5. The ſetting of the ſun's centre, for the horizon of *Witemberg* was found to be at $7^h\ 39'\ 49''$; and conſequently, by the refraction of the rays in the clouds in the horizon it was retarded 6 min. of time nearly.

An Abſtract of Meteorological Diaries; *with Remarks thereon; by Dr.* Derham. Phil. Tranſ. N° 433. p. 334.

THE following meteorological obſervations were very carefully made in 1726 (ſome twice and ſome thrice every day) at *Berlin*, by the Society there; at *Lunden* in *Sweden* by *Conrad Quenſel*, Profeſſor of the Mathematics in the *Caroline* Academy; at *Bettna* in *Sudermanland*, by *Andr. Geringius*, Paſtor and Provoſt of the place; at *Upſal* by *Eric Burman*, Profeſſor of Aſtronomy in the *Guſtavian* Academy; at *Bygdea* in *Weſtro-Bothnia* by *Jacob. Burman*, Paſtor of the place; and at *Pythea* in the ſame province, by *Olave Burman* and *Iſrael Steckſenius*, ſtudents.

The moſt uſeful of the barometrical obſervations are exhibited in the following table, which readily ſhews the higheſt, loweſt, and mean, heights of the quickſilver in every month, at the ſeveral places.

JANUARY.

	Berlin	Lun.	Bett.	Upſa.
High.	29.3	30.0½	30.51	30.18
Mean	28.7½	29.3⅛	29.92	29.58
Low	28.0¼	28.5¾	29.26	28.98

FEB.

February.

	Berlin	Lun.	Bett.	Upsa.
High.	29.6	29.8$\frac{3}{4}$	30.40	30. 2
Mean	28.6$\frac{1}{4}$	29.1$\frac{1}{2}$	29.74	29.53
Low.	27.6$\frac{3}{4}$	28.4$\frac{1}{4}$	29. 8	28.86

March.

	Berlin	Lun.	Bettna	Upsa.	Pithea
High.	29. 0$\frac{3}{4}$	30.0$\frac{1}{2}$	30.50	30.24	30.11
Mean	28. 5	29.4$\frac{1}{2}$	29.79	29.28	29.35
Low.	27.10$\frac{1}{2}$	28.8$\frac{1}{2}$	29. 8	28.32	28.50

April.

	Berlin	Lun.	Bettna.	Upsal	Pithea
High.	28.10	29.9$\frac{1}{2}$	30.48	30.17	29.98
Mean	28. 5	29.5$\frac{7}{8}$	29.86$\frac{1}{2}$	29.66	29.27$\frac{1}{2}$
Low.	28. 0$\frac{1}{5}$	29.2$\frac{1}{4}$	29.25	29.15	28.57

May.

	Berlin	Lun.	Bettna	Upsa.	Pithea
High.	28. 9$\frac{1}{4}$	30.0$\frac{1}{2}$	30.40	30.16	30.11
Mean	28. 4$\frac{1}{5}$	29.7$\frac{3}{8}$	30.77$\frac{1}{2}$	29.84	29.74$\frac{1}{2}$
Low.	28.00 $\frac{1}{2}$	29.4$\frac{1}{4}$	29.35	29.52	29.48

June.

	Berlin.	Lun.	Bettna	Upsal	Pithea
High.	28.7$\frac{1}{2}$	29.9$\frac{1}{2}$	30.20	30.00	29.98
Mean	27.9$\frac{1}{4}$	29.4$\frac{1}{2}$	29.67$\frac{1}{2}$	29.62$\frac{1}{2}$	29.56$\frac{1}{2}$
Low.	27.0$\frac{1}{2}$	28.9$\frac{1}{2}$	29.15	29.25	29.15

July.

	Berlin	Lun.	Bettna	Upsa.	Pithea
High.	28.5$\frac{4}{5}$	29.6	30. 5	29.88	29.56
Mean	28.2$\frac{3}{4}$	29.2$\frac{3}{4}$	29.70	29.54	29.37$\frac{1}{2}$
Low.	28.0$\frac{1}{4}$	28.9$\frac{1}{2}$	29.35	29.20	29.19

August.

	Berlin.	Lun.	Bettna	Upsal	Pithea
High.	28. 8	29.8$\frac{3}{4}$	30.30	29.98	29.86
Mean	28. 3$\frac{1}{4}$	29.3$\frac{5}{8}$	29.65$\frac{1}{2}$	29.48	29.28$\frac{1}{2}$
Low.	27.11$\frac{4}{5}$	28.8$\frac{1}{2}$	29. 1	28.98	28.71

SEP-

SEPTEMBER.

	Berlin	Lun.	Bettna	Upsal	Pithea
High.	28.6	29.7¾	30.28	30.00	29.80
Mean	28.1	29.1¾	29.57	29.29	29.20
Low.	27.8	28.5¾	28.87	28.58	28.60

OCTOBER.

	Berlin	Lun.	Bettna	Upsal	Pithea
High.	28.10	30.1½	30.55	30.25	29.90
Mean	28. 3½	29.1⅞	29.57½	29.28½	29.05
Low.	27. 9	28.2¼	28.60	28.32	28.20

NOVEMBER.

	Berlin	Lun.	Bettna	Upsal	Pithea
High.	29.1	30.1½	30.80	30.51	30.19
Mean	28.7	29.5½	30.00	29.73	29.24
Low.	28.1¼	28.9½	29.20	28.90	28.29

DECEMBER.

	Berlin	Lun.	Bettna	Upsal	Pithea
High.	29.1⅔	30.0¼	30.50	30. 7	29.80
Mean	28.4¾	29.5½	29.65	28.83½	29. 0½
Low.	27.8¼	28.4¼	28.80	28.60	28.21

Tho' this table may give a good view of the barometrical ranges at the several places in every month of the year 1726; yet Dr. *Derham* thinks it necessary to take notice of the great agreement between the ascents and descents of the mercury, sometimes at the very same time, and generally near it. If the mercury was remarkably high or low, it was so in all or most of the places: If stationary for 3 or 4, or more days, it was the same in all; only the alteration would begin or end, somewhat sooner or later, perhaps in one place than the other; and when there was any deviation from this rule, it was commonly most remarkable in the *Pithea* observations.

As to the thermometrical observations, the Dr. could give no account of them, by reason he did not understand the thermometers made use of, nor the freezing, temperate, or other points; only the *Upsal* thermometer (which was made by Mr. *Hauksbee*) must serve for all; in which the point of extreme heat is marked 5 degrees above 0, and so is graduated downwards to 45 degrees, which is the point of temperate, and 65 degrees,

degrees, which is the point of freezing. The mean of all th degrees of every month at *Upsal* M. *Burman* hath noted, ac cording to Dr. *Jurin's* directions in *Phil. Trans.* N° 379 which is, by adding the whole degrees of the month, and di viding by the number of days; which mean degrees Dr. *Der ham* has inserted, as well as his own; which last are the mear between the highest and lowest degrees, as well of the thermo meter as barometer.

A table of the mean barometrical stations by Dr. *Jurin* way.

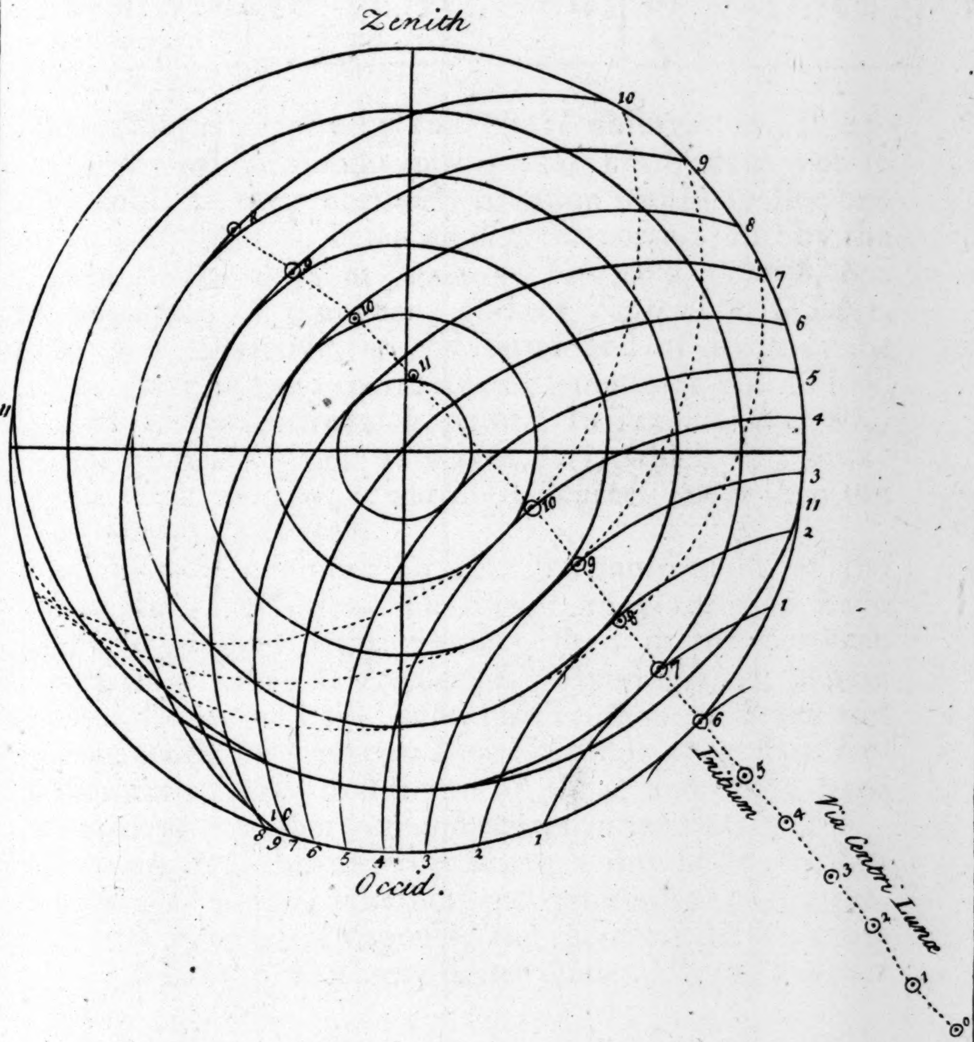
January.		February.		March.	
Upsale	Pithea	Upsale	Pithea	Upsale	Pithea
29.76 $\frac{10}{31}$		29.47 $\frac{11}{14}$		29.51 $\frac{3}{31}$	29.28 $\frac{1}{18}$
April.		**May.**		**June.**	
Upsale	Pithea	Upsale	Pithea	Upsale	Pithea
29.76 $\frac{2}{3}$	29.49 $\frac{7}{15}$	29.91 $\frac{12}{31}$	29.82 $\frac{23}{31}$	29.59 $\frac{11}{15}$	29.49 $\frac{3}{5}$
July.		**August.**		**September.**	
29.53 $\frac{11}{31}$	29.38 $\frac{13}{19}$	29.54 $\frac{17}{31}$	29.27 $\frac{10}{31}$	29.34 $\frac{19}{30}$	29.14 $\frac{1}{6}$
October.		**November.**		**December.**	
29.43 $\frac{13}{31}$	29.11 $\frac{17}{30}$	29.81 $\frac{1}{10}$	29.49 $\frac{23}{30}$	29.66 $\frac{23}{31}$	29.19 $\frac{2}{31}$

A thermometrical table of the highest, lowest, and mean stations at *Lunden* and *Upsal*; together with the mean station at *Upsal* according to Dr. *Jurin's* method.

	January.			February.			March.		
	Lun.	Upsa.	Upsale	Lun.	Upsale		Lun.	Upsale	
High.	79	96.		85	83.7		111	82.0	
Mean	58 $\frac{1}{8}$	74.8	81.2 $\frac{1}{31}$	65 $\frac{1}{2}$	74.3 $\frac{1}{2}$	74.1 $\frac{21}{28}$	84 $\frac{1}{2}$	67.5	69.1
Low.	38	67.7		56	65		58	52.4	
	April.			**May.**			**June.**		
High.	149	60. 9		187	47. 8		188	46. 7	
Mean	116	56.56	53.7 $\frac{17}{31}$	156	32.54	33.0 $\frac{2}{31}$	158 $\frac{1}{2}$	30.55	34.0
Low.	83	43. 3		125	18. 1		129	15. 4	

JUL

Fig. I.



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	JULY.			AUGUST.			SEPTEMBER.		
	Lun.	Upſa.	Upſale.	Lun.	Upſa.	Upſale.	Lun.	Upſa.	Upſale
gh.	173	42. 4		156	52. 2		168	62.7	
ean.	146	32.54	$33.7\frac{15}{30}$	$134\frac{1}{2}$	41.60	$43.5\frac{13}{31}$	133	50.4	$43.5\frac{1}{31}$
w.	119	23. 4		113	32. 8		98	38.1	
	OCTOBER.			NOVEMBER.			DECEMBER.		
gh.	122	70.7		90	84.3		83	94. 8	
ean.	$102\frac{1}{2}$	61.7	$61.8\frac{27}{31}$	71	73.0	$72.12\frac{1}{8}$	61	80.57	$79.8\frac{5}{31}$
w.	83	52.7		52	62.3		40	67. 7	

By this table, eſpecially by the *Upſal* obſervations, it appears, that the colder months in this year 1726, were not ſo exceſſive cold, as their northerly ſituation would incline one o imagine; *Upſal* itſelf being 60 degrees north. But by the able, ſome of the days in *January*, *February*, *March*, &c. t the beginning of the year; and of *September*, *October*, *November* and *December*, at the latter end of it, may be bſerv'd to have had the thermometer ſometimes not ſo low, r very little below the freezing point. In *January* and *December*, for inſtance, when it was at 67.7, which was lower han in the other months, it was not 3 degrees lower than the reezing point at 65 degrees.

But by the beſt judgment Dr. *Derham* could make of the hermometrical obſervations at *Berlin*, they ſeem to have ad no leſs, if not more ſevere weather, than in the northern arts, particularly than at *Lunden*, *Upſal* and *Pithea*, where he weather ſeems to have been milder than at *Betna* and *Bygdea*; at which two places, the Dr. finds they had frequent ſhowers of rain and ſtorms of ſnow, and more hard weather than at the other *Swediſh* places, or at *Berlin*.

What the cauſe of this different warmth ſhould be, the Dr. eaves others to judge; whether the proximity of the ſea, r the warmth of mineral vapours, and their woods ſkreening ff the cold winds; to which two latter *Olaus Magnus* aſcribes great deal.

But for the better judging of the ſtate of every month, ake the following view, which the curious author of the *Betna* obſervations hath given; together with ſome remarks f the Dr's own from the other places.

In *January* he ſays, the winter cold (which was very intenſe from the 23 of *December* to the 15 of *January*) began

to abate, to the disadvantage of the roads and travelling. In *February* the winter weather continued all the month, to the middle of *March*, with some snow, and frost enough to benefit the roads and travelling. *March* he says began with snow, stormy and bitter cold; but towards the latter end, the weather was milder, and more seasonable for agriculture, just begun. On the 14. and 17. there was an *aurora borealis*

On the 17. and 22. of *March* there were likewise signs of *auroræ boreales* at *Berlin*; as also on the 23. of *February*.

At *Upsal* there was also a *lumen boreale* on the 27. of *February*, the 3, 15, and 16 of *March*.

In *April*; *Betna* is said to have a seasonable seed-time, and that the autumnal corn, which had escap'd the worm (a calamity common in those parts as in *England*) began now to flourish.

At *Lunden* they had *parhelia* on the 28. and 29. of *April*.

At *Upminster* we had the *aurora borealis*, or streaming, on the 12. of *April* in the evening.

In *May* the observer at *Betna* takes notice, that by the continual and pernicious heat of the sun in this month, the corn was burnt up in such manner, as to be a sad presage of an ensuing scarcity and dearth of provisions.

And likewise at *Upsal* and *Berlin* they mention great drought and excessive heat of the sun. But in some parts of the month, the air at *Berlin* is said to have been coldish. In *June* the violent heats were abated, and the season was more moist and rainy. The corn being too soon ripe caus'd their harvest to fall out at a very unusual season.

At *Lunden* and *Berlin* it was cold several days and irksome.

July was a rainy month at *Berlin*, and in most of the *Swedish* places; at *Pithea* the least. At *Betna* it was very unwelcome to the harvest people. There was also much thunder and lightning in most of the places, chiefly at *Upsal*.

In *August* the Dr. finds a greater agreement between the winds than in the other months; they, in most of the places, blowing from some of the points between the W. and S. At *Berlin* and *Upsal* there was a deal of rain; at *Pithea* thunder, and at *Betna*, the beginning of the month, being mild and fair, is said to be a good seed-time; but it is remarked, that for want of rain the seed did not come up well.

Sept-

September was a very rainy month in all the *Swedish* places; very cloudy, and some misty and snowy at *Pithea*; but at *Berlin* better weather. At *Lunden* there was a parhelion on the 11th of *Sept.*

In *October* the *Swedish* places had several *auroræ boreales*. At *Lunden*, on the 8, 12 and 24. At *Betna*, on the 8, 10, 12, 13, 15, 22 and 26. At *Upsal*, on the 3, 6, and especially the 8. And at *Upminster*, the same evening of *October* 8, a very remarkable whitish list, or girdle, went cross the heavens, from west by south, to east by north, about half a degree broad; which continued but a little while, and then the whole hemisphere was cover'd with streaming vapours, emitting lances every where that pointed towards the zenith, where they formed a canopy, sometimes reddish, sometimes darker, and sometimes blazing, as if set on fire, and emitting lances every way, so as to make an appearance like the star which the Knights of the Garter wear. This canopy mov'd sometimes some degrees eastward, and then would return back again near the zenith. When the vapours and lances shone out most, the Dr. observ'd a strange commotion and working in them, as if some large body was behind them and disturbed them.

The weather in this month was rain and hoar-frost in the *Swedish* places, with a deal of snow at *Pithea* and *Bygdea*; a parhelion at *Lunden Oct.* 14: And the *Betna* observer saith, that the plenty of rain this month caus'd the corn to thrive much; and he reckons the 31st of this month to be then the first winter day with them; it being frosty, and abundance of snow. At *Berlin* it seems to have been a dark and cloudy month, with irksome cold towards the latter end.

At *Lunden* there were *auroræ boreales* on the 2, 7 and 8 of *November*; at *Betna* the 2; at *Lunden* and *Upsal*, it was cloudy, foggy, frost and snow; at *Bygdea*, *Pithea* and *Berlin*, fairer with frost and severe cold. At *Betna* the cold was very intense; the heavens very cloudy and misty.

In *December*, there were *auroræ boreales* at *Lunden* on the 5, 6, 7, 8, 9, 10, 14, 15, 16 and 22 days; and at *Upsal* on the 5 and 6; and at *Berlin* there were signals of the *auroræ boreales* on the 7 and 12; at *Lunden* frost and snow, cloudy and fogs; at *Upsal* some cloudy and foggy, and sometimes a pretty deal of fair; at *Berlin* much frost, cold, and a great storm of wind on the 23; at *Pithea* frequent snow, and some

fair, ſome cloudy. *Betna* had moderately ſnow, but twice more intenſe cold, to the great benefit of the roads and travelling.

For the better underſtanding the preceeding obſervations, it is to be obſerv'd, that the *Lunden* barometrical obſervations were made with a barometer, graduated according to *Engliſh* meaſure into inches, and the Dr. ſuppoſes, decimal parts of inches: But the thermometer he underſtood not: The *Betna* barometer is alſo graduated in the ſame manner into *Engliſh* inches and centeſimals. The *Upſal* barometer and thermometer were both made by Mr. *Hauksbee*, and conſequently are according to *Engliſh* meaſure, the barometer having inches and centeſimal parts, the thermometer as before deſcribed. The *Bygdea* obſervations had none thermometrical or barometrical, only a verbal account of the weather, and now and then of the winds. The *Pithea* obſervations had none thermometrical; and thoſe of the barometer ſeem to be in inches and centeſimal parts.

Of Ambergreaſe; *by Dr.* Neuman. Phil. Tranſ. N° 433. p. 344. *Tranſlated from the* Latin.

TWO things in phyſick Dr. *Neuman* has often been juſtly and very much ſurpriſed at; 1. That we have no certain accounts of ſome ſpecies, which have for a long time; nay, ſome of them for ſeveral ages, been uſed in pharmacy; ſo that in *Europe* alone, there is yearly conſumed ſeveral hundred weight of them; eſpecially of the various exotic vegetables, as myrrh, *gum animæ*, *carannæ*, *ſanguis draconis*, *ſemen cinæ*; and ſeveral other ſpecies in the other kingdoms; and yet as to their natural hiſtory, native ſoil, origin and manner of production, we are entirely at a loſs; and our accounts of ſome of them are doubtful, various, contradictory, and generally by hearſay only.

2. That few pharmaceutic ſubjects, tho' in uſe for ſo many ages back, are hitherto but little known, as to their true compoſition and conſtituent parts, and their peculiar and real nature; and that we are ignorant of the demonſtrable, ſeparable parts they may contain, not only the viſible, but chiefly the parts perceivable by the ſmell and taſte, and which are really active: And that we are at a loſs in what ſeparable ſubſtance, and part of the natural compound (tho call'd a ſimple by the vulgar) the eſſential characteriſtic, which diſcovers itſelf by its ſpecific ſmell, taſte and virtue does eminently reſide: Whereas the greateſt part of our

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accounts is taken from travellers, merchants, druggiſts and politicians, who are generally unſkilled in medicine and natural hiſtory, and from jeſuits, monks, ſoldiers, ſailors, fiſhermen, miners, gardeners, nay even ſome phyſicians, who are not ſufficiently grounded in the experience of true chemiſtry and demonſtrative phyſic: And theſe accounts have been tranſcribed, and credited; and continue to be ſo ſtill; yet upon an impartial and unprejudiced examination; what has hitherto been ſo ſaid, written and credited, is found to be nothing leſs than the real truth, but rather the contrary. The blunders in phyſic as to theſe two circumſtances are ſcarce to be imagined, could not ſeveral inſtances be adduced to that purpoſe: The Dr. had for ſome years propoſed to himſelf, and at the ſame time taken no ſmall pains to examine carefully the common ſpecies; and the reſult was, that he diſcover'd many truths, and expoſed ſeveral falſe accounts and chimerical notions.

He indeed owns, that he met with inſurmountable obſtacles in a great many things relating to the firſt circumſtance, namely the natural hiſtory; partly, as he himſelf had not been in the native country of theſe exotic animals and vegetables; partly as the accounts of them in books are merely equivocal, uncertain and entirely diſagreeing with their preparations; and partly likewiſe becauſe in many, eſpecially, moſt of the mineral ſpecies, it is impoſſible to be preſent at their generation and manner of production, or ſo viſibly obſerve it, as we may probably to greater advantage in vegetables and animals; on which account, he ſo much the more ſeriouſly applied himſelf to the ſecond circumſtance, namely the inveſtigation of the compoſition of natural ſubſtances, that he might, at leaſt have a thorough knowledge, as to their natural compoſition, of the things commonly made uſe of in the ſhops, whether from the *Eaſt* or *Weſt Indies*, *Europe* or *Africa*; and whether they be vegetables, animals or minerals, or of whatever denomination they commonly are, before they are made into medicines or other preparations for common uſe: In this diſquiſition he eſpecially made uſe of a nice chemical analyſis, and that the rather, as he found the methods by microſcopes, geometrical figures, and by pneumatical, hydroſtatical and the other uſual ways of trial, not only manifeſtly inſufficient, but often fallacious; nay, of little ſervice in phyſico-chemical or demonſtrative diſquiſitions.

The ſubject of the Dr's preſent diſquiſition is ambergreaſe, commonly us'd in the ſhops; it has been much and long dif-

disputed, what it properly is: And by some accounts of it latterly from *America*, it should seem it was certainly discover'd, what it really is; but as these accounts do not agree with the chemical analysis he made of this matter, he could not receive them as decisive; and he was therefore induced to write the following account, in order to excite the enquirers into nature, both in *America* and elsewhere, to gain farther certainty in this affair.

Not to enter into an etymological disquisition of the term *ambra*; he thinks it sufficient, that it is now commonly used, and its meaning universally understood: And not to mention the several sorts of amber, it is observable what *Ulysses Aldrovandus* affirms in his *Musæum Metallicum lib.* 3. *cap.* 21. p. 436; that under the general term *ambra* is understood the whole genus of amber; and that at this day ambergrease is call'd by some *succinum orientale*, as for some time back, the common amber has usually been call'd *succinum occidentale*, to distinguish it from the oriental: But it is a thing well known, that among several *European* nations, the term *ambra* without any adjunct, denotes common amber; from which observation he is induced to think that the ancient *Prussians*, who used the term *ambra* to denote both common amber and ambergrease, had at that time a true idea of ambergrease, as to its nature or constituent parts.

He cannot but own, that considering the many various and different opinions that formerly have been, and still are entertain'd about ambergrease, that produce of the sea, he seems as if he would plunge into a wide ocean of opinions, and there from so many uncertain accounts and descriptions draw a certain conclusion: For, there are doubtless very few things in nature, to which so many different ways of formation have been ascribed as to this subject; and not content with the three kingdoms, they have devised two more, in which they have classed it, as the aerial and marine; tho' the whole sea with all its contents be reducible to any of the three common kingdoms of nature, the mineral, vegetable or animal.

Oelven is the only one, as far as the Dr. knew, who classed ambergrease in the aerial kingdom, taking it for a meteor, or something generated in the air; and this manifestly absurd opinion he endeavours to support by several reasons, which notwithstanding are of no great weight; besides, that it is sufficiently confuted from the weight of ambergrease, which sometimes amounts to 100 pounds, and from its substance, and the composition of its essential parts.

Many

Many have recourſe to the animal kingdom, yet without entirely quitting the aerial : for, they hold that ambergreaſe derives its origin from ſuch creatures as fly in the air, tho' this again be with a remarkable difference, which divides them into two claſſes ; the firſt ſuppoſes ambergreaſe to be the dung of birds, and they are led into this opinion from the becks, claws, and other parts of theſe creatures being ſound therein : nay, they deſcribe the very bird, affirming it to be as big as a gooſe, with beautiful and ſpotted plumes, and in the *Maldivian* language call'd *Anacangripaſqui*, and in that of *Madagaſcar*, *Aſchibobuck*. *Ferdinandus Lopez* de *Caſtagneda*, lib. 4. cap. 35. and others are of opinion, that this bird eats ſeveral fragrant herbs, and depoſits its precious dung upon the rocks in and about the ſea ; which dung after being digeſted and concocted by the ſun in the day time, and depurated by the moon in the night, and conſequently ripened, prepared, and perfected by both luminaries into ambergreaſe ; and afterwards in ſtormy weather waſh'd off by the waves, is carried floating into the ſea ; and at length, either driven aſhore, ſuch as it was waſh'd from the rocks, or ſwallowed by whales ; who, being unable to digeſt it, do generally throw it up again in a ſhort time.

The other opinion on ambergreaſe is, that it is produced by bees, and that it is their wax ; of this opinion chiefly is Denis, *Rec. des Mem. & Conferen. ſur les Arts & les Sciences 1672. M. Aug. p. 222. It. Mediſeri Coſmograph. Tom. I. p. 101. It. Ejus deſcriptio inſulæ Madagaſcar, cap. 6. p. 43. It. Odoardus Barboſa. It. Andr. Tevet. and Franc. Belloforeſtus.* Monconys *in Itinerar. ſuo Edit. Pariſ. en ſuite de la 2. partie, p. 143. It. Edit. Londinenſ. p. 71. Lemery, traitè univerſ. des drogues ſimples.* And. Pomet, *hiſt. generale des drogues, P. 2. lib. 1. p. 57.* if not the greateſt part of the *French* nation : Both opinions agree in moſt particulars, as that the ambergreaſe is waſh'd off from the rocks, that it is digeſted and concocted by the ſun, *&c.* and that they only differ in that the one ſpecifies bees, the other birds ; the one bees-wax, the other the excrements of birds : yet both ſuppoſe them winged animals : The ſum of the latter opinion is, that there is a certain kind of bees in thoſe places, where ambergreaſe is uſually found ; that theſe bees make their hives upon the rocks and about the ſea-ſhore, (but others propoſe the matter more ſubtily, by ſaying, that the bees do not make their hives upon, but below the rocks, namely, in their caverns from whence the waves of the ſea waſh them off in the ſame manner as they did the excrements of the birds ; and they are afterwards digeſted,

gested, attenuated, toasted and alter'd in such a manner by the continual agitation of the waves, the accession of the salt water, and the co-operation of the sun, as at length to become ambergrease, and under this form thrown out upon the shore: The sticklers for this opinion endeavour to establish it farther from that white, tenacious and viscous substance, that is usually precipitated from the essence of ambergrease, and which they take to be something waxy.

That both these opinions are false is plain from the following circumstances. 1. A sufficient quantity of ambergrease is found in these places, where there are neither birds nor bees. 2. And even where there are few or no rocks. And 3. where these rocks have neither excrements of birds, nor bees-wax.

In particular; that the opinion on the excrements of birds is false and erroneous, does moreover appear from the following particulars. 1. The parts of birds, sometimes found in ambergrease, are not the bills or claws of geese, but only small and fine particles. 2. It does not appear how the bills, claws, *&c.* of other birds should pass into the body, or excrement of these. 3. The eating of fragrant herbs does by no means produce a fragrant dung. 4. It is contrary to universal experience, that the sun should by digestion give a fragrant smell to such excrements; on the contrary, it rather causes and promotes putrefaction; by which means there is produced not the fragrant smell of ambergrease, but a nauseous ungrateful stench; especially, if there is a great collection of soft excrements, as there is often large and viscid masses of amber; or even the sun extracts the fragrant particles, when smaller masses of dry excrement, such as that of several birds, are exposed to its beams; so as at length to appear quite dry, like a lean earth. 5. This dung of birds in its greatest part, if not dissolved by the waves, would at least be divided into minuter parts, tho' never so strongly irradiated by the sun and moon. 6. We are not to suppose that the waves would wait, till the excrements were sufficiently concocted and digested by the sun and moon, but wash away indiscriminately both the fresh and digested excrements; and the former would the more readily be dissolved and dissipated in the water; but then whence could we have these large, uniform solid pieces of amber, as sometimes to weigh a quarter of a hundred, half a hundred, nay, a whole hundred weight. 7. Such as fish for amber, know of no such birds and their excrements. 8. Should we conclude from the bones, bills and claws of birds, found in ambergrease, that it is their dung, we might equally infer, that

that it is the excrement of ſhell-fiſh and other fiſhes; ſince many parts of theſe are found therein. 9. The ſubſtance and natural compoſition of ambergreaſe, nay, in fine, its chymical analyſis contradict this opinion; ſince it yields no ſigns of excrements.

And this may alſo ſerve to confute the other opinion about bees-wax: for 1. No ſuch kind of bees and bee-hives have been mentioned by any one, either in *Aſia* or *America*, excepting *Denis* and *Monconys*, and ſuch as take their relations on truſt. 2. Suppoſing never ſo many bee-hives in the rocks near the ſea, every one knows that honey is apt to diſſolve or gradually run in water, even tho' it ſtood immoveable and ſoaking therein; but much more ſo ſhould it be ſtirred and agitated, as muſt be the caſe in a ſtormy ſea. 3. Conſequently this honey could by no means become more ſolid, firm, and compact, much leſs be collected into that large uniform maſs like ambergreaſe. 4. The honey thus diſſolved and waſhed away, we ſhould have nothing left but empty honey-combs. But where do we ever find parts of ſuch figure in ambergreaſe.

Borelli, it is true, *Obſervat. Med. Phyſ. Cent.* IV. *Obſervat.* 66. rejoins, that theſe honey-combs are afterwards fill'd with ſeveral things from the ſea, and ſo become ſmooth and firm: But this is a giving up the origin he contends for, *viz.* That ambergreaſe is derived from bees only, ſince the honey-combs could not be filled with any wax from the ſea, nor fortuitouſly with ambergreaſe; but if we are to ſuppoſe them filled with any matters, which yet remains to be proved, they muſt be of different natures, according as this or the other thing happens to lodge therein: And muſt all theſe different ſubſtances be inſenſibly converted into true ambergreaſe? Strange notions indeed. 5. But ſhould any one object, that the wax is collected into one maſs by the heat of the ſun, the anſwer is: This does not appear from experience, be the honey-combs never ſo much expoſed to the ſun. And ſuppoſing the wax thus collected into a maſs, yet it would have a uniform appearance, and remain of that appearance, which does not agree with ambergreaſe in its variety, appearance, and relation. 6. Wax never of itſelf takes fire, before it is melted; but this ambergreaſe does. 7. Wax and honey have and retain their ſpecific ſmell, which does not at all agree with that of ambergreaſe. 8. Chemiſtry alone evinces, that in examining ambergreaſe, it gives no ſigns of honey or any waxy ſubſtance; nor can M. *Lemery* himſelf, *in loc. citat. & in ejus curſu Chymiæ*,

prove that white and viſcous matter which precipitates in the eſſence of ambergreaſe, and on which he principally builds, provided he examine it more accurately, to be a waxy matter. Dr. *Kæmpfer* in his *Amœnitat. exotic.* p. 632, 633, 634, who himſelf was in *India*, plainly contradicts theſe authors; eſpecially if they add this groſs circumſtance, namely, that there has been ambergreaſe found with crude honey in it: For, ſays he, 'All the modern *French* authors are miſtaken, who follow '*Denis* in this matter.

To come now down to the vegetable kingdom: *Sylvaticus in Pandect.* affirms that ambergreaſe is a gum; but this opinion is ſhortly confuted by only conſidering its compoſition and conſtituent parts; it neither ſhews itſelf a gum-roſin, ſome part of which at leaſt ſuffers a ſolution in water; nor much leſs a pure gum, which ſhould diſſolve entirely in water: But the contrary rather plainly appears in ambergreaſe; conſequently it is no ways gummy.

Others hold ambergreaſe for a roſin, *Alexand. Geraldin. in Itinerar. ſuo ad Pontif. Leo. X. ex Libavio lib.* IV. *Singular. cap.* 2. *in Scholiis p.* 320 *a Dno. Boyle*, Vide *Phil. Tranſ. No.* 97. *p.* 6113 *and ſeq.* or for a balſamo-reſinous matter of certain unknown trees near the ſhore, from which it trickles and runs down into the ſea; where floating about, it is ſaturated with ſalt-water, and at the ſame time digeſted by the ſun, and at length concocted into true ambergreaſe. But this opinion ſavours much of the fable: Becauſe, 1. Such trees ſhould be planted very near the ſea, if the roſin muſt trickle down into it: 2. They muſt ſtrike their roots very deep, leſt from their nearneſs to the ſea, they ſhould be undermin'd, or quite overturn'd and waſh'd away by the continual beating of the waves upon them. 3. If each trickling drop or little maſs ſhould fall into the ſea, and be immediately ſurrounded by the water, their union into large lumps, ſuch as ambergreaſe is found in, would become very difficult, if not impoſſible: and it is triffling to call in the aſſiſtance of the ſalt-water, the digeſtion and concoction of the ſun in that troubled and cold element, the ſea. 4. Sailors, and ſuch as fiſh for ambergreaſe, whether natives or ſtrangers, in the places where it is found, know nothing of theſe trees; as the celebrated *Geo. Eberhard Rumpffius* has alſo abundantly ſhewn. *Valentini Oſt-Indiſche Sendſchreiben ſub* N° XI. p. 56. 5. In fine, its not mixing with expreſs'd oils, and ſeveral other things manifeſtly ſhews that it is no vegetable roſin.

Aver-

Averhoes, in *Colliget. cap.* 56. affirms, that ambergreaſe is a ſpecies of camphire; but as he did not underſtand what camphire was; and as they greatly differ in volatility, ſolubility, colour, ſmell, and in ſeveral other properties, they muſt be as oppoſite as light and darkneſs.

Others on the contrary hold ambergreaſe for the produce of a certain fruit, (*Nic. Monard. de ſimplicibus Medicam. Edit. Plantin. Antv. p.* 13.) which the whales are fond of and ſwallow down, and from which there is generated in their bodies a perfect ambergreaſe; but this chimera deſerves no anſwer.

Julius Cæſar Scaliger and *Serapius* (*Juſti Fidi Klobii ambræ hiſt. p.* 18.) took ambergreaſe for a ſpecies of muſhroom growing at the bottom of the ſea, from which at length looſen'd, it floated on the ſurface, and was thrown out on the ſhore; but this opinion refutes itſelf; becauſe, there is no muſhroom without ſome diſtinguiſhing characteriſtic form; a circumſtance that ill agrees with ambergreaſe.

Libavius lib. 4. *ſingularium cap* 1. and *Weckerus in ſpeciali lib. ſect* 2. *p.* 79. It. *Sylvaticus in Pandect.* take ambergreaſe for the froth of the ſea: But the following circumſtance alone is ſufficient confutation; namely, that in thoſe places, where the ſea foams moſt violently, or where its froth is in greateſt plenty, there no ambergreaſe at all is found; which, were their hypotheſis true, ſhould be moſt plentiful there.

Hieronymus Cardanus, *de ſubtilitat. p.* 284. takes amber for *ſperma ceti*: But how widely they differ is ſufficiently evident to every one.

Eichſtadius, in *lib. de confect. alkermes cap.* 12. and *Fragoſus in lib. de medicam. ex Indiâ in Europ. delatis cap. de ambaro p.* 89. affirm that ambergreaſe is the liver of ſome fiſh: But every body knows, that the liver has its *capſula* or *parenchyma*, and conſiſts of filaments of veins and arteries, which are by no means found in ambergreaſe; not to mention that what is got by diſtillation from a liver is quite different from what ambergreaſe yields.

Moſt who are ſticklers for the marine kingdom, as it is called, were of opinion, that ambergreaſe is produced from fiſhes; yet theſe again run into various opinions, reducible to three general claſſes, which afterwards ſubdivide into ſeveral ſmaller branches.

To give ſome idea of this matter. 1. Some affirm that ambergreaſe is manifeſtly generated in fiſhes. 2. Others with more reaſon, that fiſhes ſwallow it floating on the ſea.

In fine, thoſe of the third claſs determine nothing on either ſide, and only affirm, that ambergreaſe is found in fiſhes; but whether generated in, or only ſwallowed by them, they mention not. From theſe three principal opinions have afterwards aroſe ſeveral ſubdiviſions, as to the fiſhes, the ſwallowing and the production of ambergreaſe; ſome affirming, that it is found in the larger fiſhes only; but others, in the ſmaller too; ſome, that it is found in all ſorts of whales; others on the contrary, in a certain ſpecies of them; tho' theſe again, differ as to the denomination of this ſpecies. They likewiſe differ as to the ſwallowing of it: For, ſome affirm that it is greedily ſwallowed by all ſorts of fiſhes; but others, by one ſpecies only; ſome, that fiſhes die of it; but others, that it does them no hurt; ſome, that it is ſoon thrown up again, after being ſwallowed; others that it is thrown out with the *fæces*: And others further contend that it is likewiſe devoured by other animals. And thus in like manner there are no leſs different opinions as to its production; both as to the manner and place where; and whether it be an excrement, or recrement, *&c.*

The Dr. only touches upon the chief of theſe different opinions, thinking it both needleſs and of little uſe to conſider each in order.

The celebrated *Rumpffius in loc. citat. Valentini ſub* N° 8. p. 50. in his letter from the iſland of *Amboina* to M. *Ten Rhyne*, and which is verified by *Gabriel Nakke* and others, ſays expreſsly, that not only the larger whales, but likewiſe ſmaller fiſhes and even birds and boars, and ſome likewiſe mention foxes, do very greedily ſwallow proportionable pieces of ambergreaſe, where they can come at it, which they afterwards throw up again: and hence he ſays it is, that there have been ſuch various opinions about ambergreaſe; ſome aſcribing its production to whales, and others to hogs; tho' it is only fortuitouſly found in them, as having been ſwallowed by them.

Of ſuch as hold, that ambergreaſe is found only in one ſort of fiſh, and in a certain ſpecies of whales; ſome who call this fiſh azel (*Geſner de aquatil. & quidem de cetis diverſis lib.* 4. *p.* 204.) affirm, that it very greedily ſwallows it, but ſoon after dying of it, it is carefully ſought for by the fiſhermen. Others call this fiſh *Mokos* (*Kæmpferi Amænitat. exotic. faſcicul.* 3. *p.* 635.) and relate that it is upwards of three or four fathoms in length; that it lives in the *Eaſt-Indies*, and is taken

aken about *Japan*. Others, as M. *Andr. Cleyer*, who liv'd a
ong time in the *Eaſt Indies*, call this fiſh *cetum ambrophagum*,
or the ambrivorous whale; and the ſaid M. *Cleyer* ſent M.
Mentzelius a draught of it; which, together with M. *Cleyer*'s
ccount, was publiſh'd *Ann.* VIII. *Dec.* 2. of the obſervations
of the Academy *Naturæ Curioſorum*. Others affirm, that it
s from a whale of the *Lamia* kind, *Valentini Oſt-indiſche
Sendſchreiben p.* 50. and others again, as Mr. *Dudley*, imagine,
hat ambergreaſe is ſolely produced from the *ſperma ceti*
whale.

Many who eſpouſe neither ſide, affirm, that ambergreaſe is
generally found in all ſorts of fiſhes, and not in any one par-
icular ſort; nor do they decide the controverſy, whether it be
ſwallowed by, or generated in them; only in this they differ,
hat they do not aſſign for it one and the ſame place in the
iſh: For, ſome, and that the greateſt number affirm, that
it is contained in the whale's ſtomach; others, in the inteſ-
ines; whence it is that ſome of theſe affirm, that the whales
hrow up the amber; but others, that they diſcharge it with
he *fæces*: All theſe opinions, however, come to the ſame
hing, and tacitly agree; *viz.* that ambergreaſe is not gene-
rated in, but rather ſwallowed by fiſhes: Since it is ſelf-
evident, that whether a thing be diſcharged by the mouth
or *anus*, it muſt needs previouſly have been in the ſtomach;
and what is diſcharged at the mouth, does certainly come
from the ſtomach: If, therefore, the ambergreaſe in the
ſtomach be not thrown up, but retain'd, then it may natu-
rally paſs farther into the inteſtines, and at length be quite
diſcharged: And it cauſes no real difference whether it be
found in the ſtomach or inteſtines; or, whether it be diſ-
charged upwards or downwards: It is a thing well known,
hat naturally there is nothing in the ſtomach but liquid
juices; on the contrary, every thing elſe, eſpecially the ſolid
and compact ſubſtances muſt neceſſarily enter by the mouth,
and ſo be ſwallowed down: If ambergreaſe therefore be
eally found in the ſtomach or inteſtines of a whale, it is un-
reaſonable to imagine, that it was naturally produced there:
Is it not rather more agreeable to nature, that this ſubſtance
be by no means generated in this animal, but originally ex-
iſting without it, and afterwards ſwallowed as food? Since
many credible authors, tho' they differ, one in affirming that
it is thrown up by whales; another, that it is diſcharg'd by
he *anus*; a third, that it is found in the ſtomach: and a
fourth

fourth, in the inteſtines; yet they agree in this circumſtance, a
a certain and undoubted truth, that ambergreaſe is ſwallow'd b
fiſhes, and by no means generated in them.

The aforeſaid circumſtances however, as that ambergris ha
been diſcharged by whales both upwards and downwards, and
that ſome of it has been found in the ſtomach and inteſtine
have betrayed ſeveral into the miſtake, eſpecially, the inhabi-
tants of *Madagaſcar*, as alſo many fiſhermen and ſailors, tha
ambergreaſe is nothing other than the excrement of the crea-
ture. The *Japoneſe* in their own language call that found i
fiſhes, or diſcharged by them, *Kuſura no fuu* (*Kæmpf. in loc.
citat. p.* 635.) which is ſaid to denote the dung of whales.

To affirm that ambergris is the excrement or dung of whale
becauſe diſcharged by them, ſeems not concluſive; as is mani-
feſt from the following inſtance: Running mercury, or pills o
regulus of antimony, call'd the perpetual pills, are ſucceſſively
taken and diſcharged by 10, 20 or more men; one diſcharge
them immediately; a ſecond retains them a longer time, and a
third probably dies with them; as the Dr. obſerved in giving
mercury in the *Iliac* paſſion: Now if both the mercury and pill
were either diſcharged or found in the body, a pure mercury
and pure *regulus* of antimony, no one therefore would take
them for any animal matter, or call them an animal excrement:
The ſame thing alſo holds of the deglutition and ſubſequent
ejection of ambergris. It is here ſufficient to obſerve, that am-
bergris is a foreign body, floating upon the ſea, which fiſhes do
greedily ſwallow down, as a tidbit; in the manner as muſh-
rooms, truffles, &c. are ſwallowed by men, but diſcharged
again indigeſted: That ambergris is ſomething foreign to fiſhes
and indigeſtible, appears from ſeveral relations. The above-
mentioned fiſh, *azel*, is expreſsly ſaid to be fond of ambergris,
and to die of it ſhortly after; but to inſiſt only on what is gene-
rally related; fiſhes diſcharge the ambergris, they have ſwal-
lowed down, either at the mouth or *anus*; and it is an un-
doubted truth, that it is very rare to find any ambergris in the
ſtomach or inteſtines of fiſhes. *Monardes* ſomewhere relates,
that in his time in the *Canary Iſlands*, 100 *lb.* weight of am-
bergris was found in the inteſtines of a whale; and that from
that time a great number of whales, ſmall and great, were kil-
led, but no ambergris found in them. To this the Dr. adds,
that in ſeveral hundreds of whales there is no ambergris, and
that what is ſometimes found in them, was either ſwallowed a
little before, or caſually retained there thro' its compacter bulk
or

r ſome other impediment, if not diſeaſe, whereby it was incapable of paſſing the inteſtines and being diſcharged.

It therefore remains an undoubted truth that ambergris is ſwallowed by ſeveral ſorts of fiſhes, but in particular, by whales; that it is afterwards diſcharged either by the mouth or *anus*; or ſometimes alſo retained in their bodies, and after death found either in the ſtomach or inteſtines; as all theſe circumſtances have for a long time back been unanimouſly verified by ſeveral perſons of undoubted credit: But we are not thence to conclude, that ambergris is produced in the ſtomach or inteſtines of theſe fiſhes; or becauſe it has for ſome time been retained in their bodies, that therefore it is ſome animal matter, referable to the animal kingdom.

The laſt opinion, reducible to this head, makes ambergris an animal recrement, and that of the whale kind; or, a matter, produced in the whale, as ſomething peculiar to it; in the ſame manner as caſtor, muſk, civet, bezoar, &c. in other animals.

A Continuation of the Account of Ambergris; *by the ſame.* Phil. Tranſ. N° 434. p. 371. *Tranſlated from the* Latin.

IN *Phil. Tranſ.* N° 385. and 387. are publiſhed two particular accounts of ambergris, tranſmitted to the *Royal Society* from *America*; the one by Mr. *Boylſton*, and the other by Mr. *Dudley*: Dr. *Neuman* here only gives a ſummary of both theſe accounts.

1. Ambergris, according to Mr. *Dudley* is found only in the *ſperma ceti* whale.

2. It conſiſts of balls or globular bodies, of various ſizes, from about 3 to 12 inches diameter, each ball weighing from 1 and ½ *lb.* to 22 *lb.*

3. Theſe balls lie looſe, in a large oval bag or bladder, 3 or 4 foot long, and 2 or 3 feet deep and wide, and almoſt in the form of an ox's bladder, only the extremeties more acute, and reſembling a black-ſmith's long pair of bellows.

With 4. A ſpout running into, and thro' the length of the *penis*. Beſides

5. A *duct* or canal, opening into the other end of the bag; and

6. Proceeding from the region of the kidneys.

7. This bag lies juſt over the *teſtes*, which are above a foot long, and is placed lengthwiſe at the root of the *penis*, about 4 or 5 foot below the navel, and 3 or 4 foot above the *anus*.

8. This

8. This bag is almoſt full of a deep orange-colour'd liquor not quite ſo thick as oil, and ſmelling ſtrong, or rather ſtronger of the ſame ſcent with the balls of ambergris, which float and ſwim looſe therein.

9. The inſide of the bag is very deeply tinged of the ſame colour as the liquor, which may alſo be found in the canal of the *penis*.

10. The balls ſeem to be pretty hard, while the whale is alive, ſince there are frequently found, upon opening the bag,

11. Large concave ſhells of the ſame ſubſtance and conſiſtence with the balls themſelves, that have ſcaled off from them.

12. And the balls themſelves ſeem to conſiſt entirely of ſuch diſtinct coats, incloſing one another, like the coats of an onion.

13. The number of balls never exceeds 4 in a bag, according to Mr. *Atkins*; who affirms that in a bag, where he found one, that weighed 21 pounds, the largeſt he ever ſaw, there was no other.

14. The whale-men obſerve, that only the old, well grown and male whales, contain ambergris: Yet at the ſame time Mr. *Atkins* relates,

15. That he never ſaw, nor certainly heard of a *ſperma ceti* female, taken in his life, the cows of that ſpecies being much more timorous than the males, and almoſt impoſſible to come at, unleſs when haply found a-ſleep, or detain'd by their calves. This is certain, the boats can never come near them, when they are awake, being very ſhy and fearful: Beſides, Mr. *Atkins* affirms,

16. That to one *ſperma ceti* whale that has any of theſe balls, there are two, that have nothing of the abovemention'd deep orange-colour'd liquor in their bags; and in fine,

17. Mr. *Dudley* in the very beginning of his account, boaſts, that after ſo long an incertainty about ambergris, he at length diſcovered this ſecret of nature to be no other than an animal production, generated in the body of the *ſperma ceti* whale, in the ſame manner as muſk, &c. in other animals. And about the end of his account he ſays, I hope the *Royal Society* will aſcribe to me the honour of the diſcovery, or at leaſt that of the aſcertaining the origin and nature of ambergris: Yet,

18. A little before he owns, that he dares not pretend to give his own opinion upon the point, but contents himſelf with relating matter of fact.

19. The

19. The greatest part of which account he had from Mr. *Atkins*, who used the whale-fishery for 10 or 12 years together, and from some other whalemen.

The sum of Mr. *Boylston*'s account, consists of the following particulars.

That ambergris is found in no other than the *sperma ceti* male whale; and in one about 20 pounds, more or less, of that drug. That it is scarcely found in one of a hundred of them. That it is contained in a *cystis* or bag. That they have sometimes found this bag empty, and yet entire. That this bag is no where to be found but near the genitals of the fish. That the ambergris, when first taken out, is moist, and of an exceeding strong and offensive smell. But whether ambergris be naturally or accidentally produced in this fish; he leaves it to the learned to determine, &c. in fine that he had his account, only from the fishermen or whale-men.

From all which, it appears; 1. That the 2 accounts abovemention'd, agree in some respects; and 2. Differ in others; yet consistently with the principal question.

Both accounts agree, 1. That ambergris is found in the *sperma ceti* male whales only. 2. That it is contained in a *cystis* or bag. 3. That there are lumps of it of 20, 21 or 22 pound weight. 4. That this *cystis* lies near the genital parts of the fish. 5. That ambergris newly taken out, is moist, and of an exceeding strong, and offensive smell; in fine, 6. That they owe their accounts and new discoveries to the fishermen and the whalemen.

They differ in the following circumstances. 1. Mr. *Dudley* affirms that this *cystis* has a duct or canal from either end of the bag; one in the upper part of the bag, coming out of the kidneys, another in the lower part, running into and thro' the length of the *penis*: On the contrary, Mr. *Boylston* affirms that this *cystis* has neither inlet nor outlet. 2. Mr. *Dudley* affirms, that tho' in some fish no ambergris be found; yet they always have orange-coloured liquor, mention'd above; But Mr. *Boylston* affirms that this bag is sometimes found quite empty. 3. Mr. *Dudley* says, that for one fish that has ambergris, there are 2 in which they hardly find any: But Mr. *Boylston*, that scarcely one in 100 has any ambergris.

These 3 differences, however, may be easily reconcil'd: As to the first, that according to Mr. *Boylston*, the bag hath no inlet or outlet; this will only arise from the negligence of the fisherman, who gave the account, and who did not observe every

particular ſo accurately as Mr. *Atkins* whale-man did: For how could the bag be found ſometimes full, and ſometimes empty, if it had neither inlet nor outlet? As to the 2d difference, namely that the bag was ſometimes found empty, this may be underſtood either of the balls only, or of the liquor likewiſe: But it is not directly contrary to Mr. *Dudley*'s account, ſince both may be natural, or happen ſo at that time: In fine, the 3d difference has no manner of difficulty, but both accounts agree, in that the pretended ambergris is found in ſome only, but not in all male whales; and as Dr. *Neuman* takes it, a certain is put for an uncertain number.

That the concrete, taken for ambergris, is true ambergris, and not ſome other very different natural ſubſtance, Dr. *Neuman* denies, and entirely agrees with Mr. *Prince*, who, according to Mr. *Dudley*, takes the aforeſaid *cyſtis* to be the urinary bladder, and the ambergris-ball, to be a certain concretion, formed out of the greaſy odoriferous ſubſtance of the aforeſaid liquor, contain'd within it. For his particular Dr. *Neuman* declares, 1. That the *cyſtis* or bag is no other than the urinary bladder of the whale. 2. That the pretended ambergris, found therein, is only the ſtone in the bladder; and 3. That the ſtrong ſcented liquor contain'd in the bag, is the whale's urine. That this bag is the urinary bladder, appears from its deſcription; as that it is 3 or 4 foot long, 2 or 3 foot broad, and almoſt in the form of an ox's bladder, or like a blackſmith's long bellows; eſpecially when we add its ſituation under the navel, over the teſticles, at the root of the *penis*; and its connection with the *penis* and kidneys, and how it is furniſhed with a ſtrong-ſcented liquor, without any of the pretended ambergris: And ſuppoſing, according to Mr. *Boylſton*, that the bladder is ſometimes obſerv'd to be empty (tho' he expreſſes himſelf leſs accurately on this head, it being probable, he meant, empty of ſtones) it would not be altogether impoſſible or unnatural, ſince the whale might happen to be killed ſoon after it had made water: What farther confirms it to be urine is, that it is found as all other urine is, in the *urethra* of the whale. That the balls have the ſame exceeding ſtrong and offenſive ſmell with the liquor, and conſiſt of diſtinct ſeparable coats like an onion, are circumſtances, common and natural to all animal ſtones as well of the urine as gall-bladder: Such a *calculus* then, is no longer to be reckon'd ambergris; nor the bladder, a peculiar *cyſtis*; nor the urine a peculiar liquor: This is farther verified from what is ſaid by Mr. *Dudley*, that the whale-men obſerve the full grown

grown and large whales only to contain ambergris, or rather a *calculus* according to Dr. *Neuman*; and by Mr. *Boylſton*, that it is ſcarcely found in one of 100: And theſe 2 circumſtances are both natural and common to men and beaſts; *viz.* that the old are ſooner troubled with the ſtone than the young; and that as ſcarce one man in a hundred is afflicted with the ſtone, the ſame may alſo happen in brutes: Beſides, the number of other animal ſtones is precarious, being ſometimes more and ſometimes fewer; and they may conveniently become round by the continual agitation in the urine, tho' the Dr. has obſerved, that the figure of *calculi*, as alſo of bezoar-ſtones, commonly ariſes from that of the *nucleus*, round which the firſt cruſt is laid; at other times their figure is owing to a greater or leſs ſpace, and a greater or leſs degree of motion: For, if they be more in number, as to poſſeſs the whole capacity of the bladder, or incapable to float and move freely about therein, they then are ſeldom round, but commonly unequal and informed, and thus they may eaſily ſeparate into flakes or coats, if they are many in number, or happen to ſtrike againſt each other: Nor does the circumſtance, that the male whales only contain theſe balls, weigh any thing with the Dr. ſince it is poſſible, that the males only are troubled with the ſtone; or we may not have ſufficient experience of this matter as to the females; and that the more as it was ſaid, that the females or cows are hard to come at; and that hardly one in a hundred of the males, according to Mr. *Boylſton*'s obſervation, is troubled with the ſtone.

On the contrary, that very circumſtance mention'd by Mr. *Dudley* and Mr. *Boylſton*; *viz.* that ambergris, which the Dr. calls a *calculus*, is not found in all male whales, and ſcarcely in one of a hundred, and only in the old ones, ſhews that it is not ſuch a recrement, as muſk, *caſtor*, *&c.* and at the ſame time confirms the Dr's. opinion, that it is no other than a *calculus*.

For, 1. were their pretended ambergris a natural recrement, generated in theſe male whales, and were that bag, ſome peculiar *cyſtis* without the urinary bladder, and the concrete found in it ſome ſuch natural ſubſtance, as muſk in the animal, that yields that drug, civet in the civet-cat, and *caſtor* in the beaver, to all which Mr. *Dudley* likens this *calculus*, generated from a morbid ſtate of the animal; then all the male *ſperma ceti* whales ſhould have this concrete, as beavers have *caſtor*, muſk-goats, muſk, *&c.* and in that caſe the bladder would not be its natural place; and all whales of that ſpecies without exception

(not one in a hundred, or the old ones only) would always and necessarily contain such balls.

2. Were this concrete generated in these fishes, and natural to them in a healthful state, as *castor*, musk, civet, *&c.* to other animals; not only the *sperma ceti* whales in *America*, but also those in the *Spanish*, *French* and *British* seas, especially in the northern ocean, would have it: And yet no such thing has been observed.

3. Mr. *Dudley* affirms, that the largest ball of ambergris he ever saw weigh'd between 21 and 22 *lb.* which, for the size of the bladder, is a pretty large *calculus*: But the Dr. queries, whence those lumps of ambergris could proceed, which were not entirely round, or of any determinate figure, yet 6 foot long, and weighing 182 *lb.* and upwards; and not coated like an onion, or friable, or of an orange-colour, much less of an ungrateful smell, and least of all fetid; but entirely unformed, firmly compacted, of a grey colour, and sweet scented? And again, whence could pieces proceed, exceeding the former in weight and size, 10, 20 times and upwards, and not to be contained in the *cystis* of the biggest and oldest whale.

4. The Dr. farther queries, how this ambergris should ever come ashore; it could not proceed from live whales; because the only outlet of the *cystis* is thro' the *penis*, thro' which indeed small pieces might pass; but not such large lumps of ambergris, as are often found. But should it be alledged, that such pieces are got from dead whales, it would remain to account for their passing out of the bag; especially, since it is membranous and of a pretty firm texture; so that its bursting after death, and discharging these floating balls is no such reasonable supposition; and it is a chance but ambergris might be sometimes found floating about in its bag, but this is a thing that has never happened to any one.

5. The becks of birds, the claws, shells, and spines, of fishes and other adventitious matters, sometimes found in ambergris, could not pass thro' the kidneys and *ureters* into the bladder, or pretended bag of ambergris.

6. And lastly, but waving all other arguments, Dr. *Neuman* adduces one, as an incontested principle, and his chemico-physical canon, by which he regulates himself in all natural disquisitions; and which never failed him, nor really can, if applied with judgment and discretion: And this was his principal motive of denying ambergris to be either an animal production or extract. It is a thing well known, that not only *castor*, musk and

nd civet, but likewiſe all animals and their parts, of whatever enomination, ſhould exhibit themſelves ſuch in a chemical nalyſis, eſpecially in an open fire or in diſtillation; and conſe-uently, neceſſarily yield an empyreumatic urinous ſpirit, or hlegm, or an animal fetid oil, or together with it an urinous olatile ſalt; and if all theſe not at once; yet ſome ſmall uantity, or at leaſt ſome ſigns of an urinous liquor or empy-eumatic animal oil, which ſhall affect the ſmell and taſte, when theſe bodies are treated in the fire; as all animal bodies eally do, and even their ſhells, theſe ſtony and earthy parts, do n this teſt betray their animal origin: And thus likewiſe ſhall he pretended balls of ambergris, which the Dr. ſuppoſes to be tones in the whale's bladder, plainly and ſufficiently ſhew by his teſt, that they are not only of a pure animal, but of a pure rinous original, as being generated from the whale's urine. But if any one on the contrary, ſhould take genuine ambergris, lepurated from all viſible animal parts, and not ſwallow'd by ny animal, and diſtil it in the ſame manner in an open fire, nd examine what is got from it; he ſhall not find even the eaſt urinous part, nor empyreumatic animal oil, nor any thing nimal, but quite different modified productions, a different phlegm, oil and ſalt, as ſhall be further ſhewn hereafter.

This, therefore, may be looked upon as an infallible ſign nd an undoubted truth; that when in the chemical treatment of ambergris the leaſt quantity of an animal ſubſtance is got, whether oleaginous, or urino-ſaline; that this can by no means be produced from pure amber, but from ſome animal matter ac-cidentally mix'd therewith, and which is always to be conſi-dered as ſomething adventitious, impure and not belonging to the compoſition of ambergris; whether the proceſs be made with ambergris that has, or has not been ſwallow'd before, but with which are mixed the becks of birds or other ſmall parts of animals.

But that ambergris ſwallow'd down by fiſhes, or other animals, ſuffers ſome degree of alteration, at leaſt ſome animal taint or foulneſs can hardly be denied; whether it be afterwards diſ-charged by the mouth or *anus*, or whether it be found and taken out of dead fiſhes: And on that ſcore it generally ſmells ranker and appears of a darker colour; nay, experience has taught even to diſtinguiſh immediately by inſpection what has been ſwallowed down; on which account it has in ſome places been called the dung or excrement of whales, as was obſerved above.

And

And ſince the 2 abovementioned accounts, tranſmitted from *America*, are from whale-fiſhers and Merchants; nay partly from hearſay: Hence we are ſo much the leſs to regard them as unqueſtionably certain or new, on the true origin and nature of ambergris.

To come now to the laſt claſs, namely ſuch as hold ambergris for a mineral, or aſcribe its origin to the mineral kingdom; theſe may be divided into 5 opinions, each of which, in a certain ſenſe, may be approv'd of.

Hugo de Lindſchott, vide *Klobii ambræ hiſt.* p. 19. takes ambergris for an earth: But this is contrary to nature and experience and the properties of ambergris; unleſs earth be taken in a wider ſenſe, as one of the chemical principles, and not for a mere earthy matter; for, earth does not ſo eaſily take fire, nor ſo readily melt, nor admit a ſolution with ſpirits of urine, not to mention other properties of ambergris.

2. Others attending only to the properties of liquation and inflammability; as *Crato, in Conſiliis a Laur. Scholtzio collect. Column.* 1093, and ſeveral others, have taken ambergris for a native and true ſulphur; Dr. *Salmon*, affirms that it is a marine ſulphur: vide *London Diſpenſatory* p. 398. *Edit. Lond.* 1696. 8*vo*: And ſuch a denomination is paſſable, were no more meant than that ambergris partakes of an inflammable or ſulphureous principle; ſince not only the ancients, but many moderns give the denomination, ſulphur, to whatever takes fire; whether it be a mineral, vegetable, or animal ſubſtance; an oil, fat, roſin, wax, pitch, balſam, wood, coals, bitumen, ſpirit of wine, or whatever elſe it be: But ſince this general denomination expreſſes nothing ſpecific or determinate; and ſince at the ſame time it appears pretty evident, that a native and true ſulphur is meant, and not the inflammable principle; ambergris can be no true ſulphur. 1. Let ambergris be ſprinkled on live coals, and its ſmell examined whether it agree with that of ſulphur. 2. Let it be tried with a fixt alcaline ſalt, whether it yield a *hepar ſulphuris*, vitriolated tartar, &c. 3. Whether ambergris again reduce *regulus* of antimony into crude antimony. 4. Whether there is a *lac ſulphuris* from a ſolution of ambergris in quick-lime water, or an alcaline *lixivium*. 5. Whether from ambergris and mercury cinnabar be produced; and whether ſeveral other preparations, which are otherways made with true ſulphur, be obtainable with ambergris. And all the attempts and proofs to that purpoſe, will become vain and ineffectual, as *Libavius* has already ſhewn againſt *Crato*.

Some

Some at length come nearer the matter, and hold amber-is not only for a mineral, but for what it really is, a bitu-ien, or species thereof; but happen to differ in some cir-umstances.

3. Some affirm that ambergrease is produced in aliquid rm.

4. But others in a dry form.

5. Others again, that it is produced in the sea in a viscous rm, or of a mean consistence.

They likewise differ, in that some affirm, that amber-ease arises from under the shore and rolls down into the a: But others attempt to shew, that it arises from the abyss, rather from the bottom of the sea.

1. Such as suppose ambergrease to have been originally uid, or conveyed into the sea in a liquid form, hold it iginally in its nature for a liquid bitumen, or species of *aptha*; and amongst these are *Ebnsina*, *Simeon Sethi*, *ævius*, *Avicenna*, *Agricola*, *Solenander*, *Bertinus*, *Liba-us*, *Garcias ab Horto*, *Hadrianus Toll*, *Joh. Eusebius ierenbergius*, *Franciscus Hernandez*, and several others, o all hold, that ambergrease rolls into the sea from a bitu-inous fountain, or fountain of *Naptha*; and they differ ly in some little circumstances, that are not material; r instance, according to *Avicenna* and *Psellus*, it flows om lateral springs into the sea: Others, on the contrary mong whom is *Nicolaus Chevalier*, who in 1700 described e large piece of ambergrease at *Amsterdam*) affirm that it ontaneously springs from the bottom of the sea, and from *ircher*'s reservoirs of water is distill'd by the central heat, it were, into the sea.

2. Others, who hold that ambergrease is conveyed into e sea in a dry form, affirm, that it is a kind of amber, or real dry bitumen, which is conveyed in the same manner to the sea, as the common yellow amber. *Andreas Cæsal-nus*, it is true, calls it a gem; however he classes it under e species of amber. The above quoted M. *Oelvin*, who ok ambergris for a meteor, yet in a certain place of his eatise *Der Monathlichen curieusen Natur-kunst. Staats-d Sitten præsenten, zweytes stuck im Februar*. 1708. p. 56. irms, that amber has a great affinity with ambergris; yet th this difference, that ambergris is found in warmer cli-ates, where flowers and aromatics arrive to their highest rfection and most fragrant smell; whereas amber, on the contrary,

contrary, is only found in the cold northern climates, and i
the colder *Baltic*; conſequently, the latter is of a coarſer an
harder ſubſtance. In fine, the experienced and learne
Dr. *Henckel*, vide *Betheſda Portuoſa* p. 74. affirms, tha
ambergris, amber and aſphaltum, or the oriental amber
common amber, and black amber, do not differ from one
another in their eſſential principles, but only in their acci
dents and degrees; which laſt opinion agrees chiefly with
experience.

3. In fine, ſuch as ſuppoſe ambergris to run in a viſcou
form, of a mean conſiſtence, into the ſea, affirm, that it is a
firſt like a ſoft pitch, or cow-turd in or upon the bottom of th
ſea, that gradually hardens: *Helbigius*, therefore, aſſert
that ambergris is neither a gum, roſin, dung of birds, no
bees-wax, but a true viſcous matter like pitch, that lie
and grows, at the bottom of the ſea, like ſea-pitch; and thi
account was ſent him by a merchant from *Batavia*, wh
had ſeen it with his own eyes, *Ephem. Nat. Cur. Decur.*
Ann. IX. *p.* 459. The above-mentioned celebrated *Rumpffiu*
in his letter to *Ten Rhyne*; *Valentini Ooſt-Indiſche ſend-ſchr*
iben, *p.* 50. ſays, that this is certain, and that he advance
nothing new, but his old opinion about the origin of ambe
gris; namely, that it is a kind of fat, that ariſes from th
bottom of the ſea, which at firſt is ſoft and viſcid, but after
wards becomes hard by the ſaltneſs of the ſea. *Aldrovand*
(*Muſ. Metallic. lib.* III. *p.* 434.) after adducing ſevera
opinions, does at length conclude to the following purpoſe
'But I reckon theſe diſtinctions of no weight; ſince I hav
'aſſerted it to be a kind of bitumen, and not the dung o
'fiſhes or whales.'

Borelli, it is true, *in loc. citat. Obſervationum*, endeavour
to form another objection, alledging that ambergris is n
bitumen; that bitumen's have an ungrateful ſmell, and ar
not fit for internal uſes: But in ſuch caſes we cannot alway
conclude from the genus to the ſpecies, nor from the ſpecie
to the genus, as appears even from common amber; fo
amber is now univerſally acknowledged for a bitumen; an
yet it has no ungrateful ſmell, but is us'd internally in
pretty large quantity and with ſafety; not to mention what
ſaid in *Act. Erudit. Lipſien. An.* 1684. of a certain ſpring i
Poland, that yields a liquid ſweet-ſcented bitumen that
good both in phyſic and diet, and has a very fragrant an
balſamic ſmell.

Nicola

Nicolaus Monardes, de simpl. medicam. p. 12. has already id; ' there are various opinions about the origin of ambergrease; but the truest is, that it is a kind of bitumen, flowing from a spring, which as soon as it touches the air, immediately hardens in the same manner, as many other concretes, as coral, *&c.* which at the bottom of the sea are soft.'

Joh. Faber. Lyncæus in Exposit. in Rech. p. 565. affirms this, therefore, is very certain, that ambergris is no other than a bitumen'.

In short, the greatest part of the writers of natural history agree in the following respects, namely 1. That there re both liquid and consistent bitumens. 2. That all bitumen's are referable to the mineral kingdom. 3. That a dry itumen is no other than a tenacious fat of the earth, and vhich readily burns; and 4. That ambergrease is endued vith the same properties; that consequently it may without ny contradiction, not only be a mineral, but likewise a eculiar species of bitumen.

Tho' something more might be added, as to the original onsistence of ambergris; one affirming it carried into the ea under a solid, another under a viscid and tenacious, and a hird under an entire liquid form; yet the Dr. sees no absoute necessity for it; since these three opinions, as being the hief of those already adduced, may be easily united, and so ombin'd together, as to be all true in a certain respect.

1. No one, perhaps, who has any solid knowledge of the origin of several subterraneous substances, will deny, that all bitumen's are originally liquid; even tho' they do not come into the sea in a liquid form.

2. That both ambergris and amber must needs be originally, if not entirely liquid, yet for some time in a viscous form; or even ambergris, when thrown out upon the shore, must at least continue of such a texture, that if it happen'd to harden in the sea, it may easily be softened by the sun: For, otherways it could not include the becks of birds, shells of fishes and their parts; as many such things are really found in ambergrease; and, as is pretty evident, such a variety of insects and other things are likewise found in amber.

3. In fine, it is pretty evident, that tho' ambergrease in an entire dry form appears like impure and somewhat soft amber, yet as a true bitumen.

What *Franciscus Hernandez* ſays on this head is worth notice; namely that ambergreaſe runs from ſome ſprings of *Naptha* into the ſea, and by ſtormy weather is thrown out upon the ſhore; that it is a very fragrant inflammable matter, one time harder, another ſofter, ſometimes friable and ſometimes flexible; ſo as in ſome meaſure to be extenſile and flexible between the teeth and fingers like wax.

Dr. *Neuman* therefore thinks. 1. That ambergris runs out of the earth into the ſea like amber. 2. But not like *Naphtha* or petrol, but in a groſſer and flexile form, and probably often of a viſcid and clammy conſiſtence. 3. That under the firſt concretion or formation of ambergreaſe, it runs together a liquid bitumen or ſpecies of *Naphtha*. 4. That large pieces may be generated at once; but generally at firſt they are ſmall; but by the acceſſion of ſeveral new layers, the ambergris may be ſometimes round, ſometimes long, or even become of any unequal form: And during its formation it is always ſomewhat ſoft, whence many matters may be entangled in it; however from time to time it may gradually harden to the conſiſtence of wax: And ſince moſt ambergris appears thus in layers or coats; this circumſtance might miſlead thoſe in *America* to imagine that it is generated in the ſame manner as the bezoar or human ſtone; tho' they might reflect that various other ſubterraneous bodies, both the bituminous, as pit-coals, alum, &c. and other minerals, as talc, ſlate, *lapis ſpecularis*, &c. conſiſt of layers, as animal *calculi* do.

As to the reſt, the Dr. thinks it not ſo neceſſary to make ſuch deep and accurate reſearches into the original and primordial production of ambergreaſe: For, who can with certainty pretend to explain the manner in which common amber is produced? How metals, ſemi-metals, gems, fluors and many other mineral concretes are generated? Very few are the ſubterraneous mixts, of whoſe manner of production we have any certain knowledge, tho' we may form a conjecture about this and the other, nay, know the nature of very many of them: The manner of their generation ſeems to be no ſuch neceſſary and uſeful knowledge; it is ſufficient for us if we know what kingdom they are of, and if we know their internal compoſition and nature; and this latter manifeſts their kingdom: And phyſico-chemical experience is the moſt genuine and infallible touchſtone for all natural mixts.

To

To conclude, it is ſurpriſing that *Paulus Hermannus*, a man ſufficient experience in the *Materia Medica*, ſhould make mention of ambergris in his *Cynoſura*: This, however is a ore tolerable conduct than that of *Leonhardus Fuchſius*, who diculouſly held all ambergris for factitious: But to wave this, t us farther conſider from whence it is brought to us.

Ambergris for the greateſt part comes from the *Eaſt-Indies*, om *Madagaſcar* and thereabouts, the *Molucca* iſlands, *Suma-a*, *Borneo*, *Cape Commorim* in *Malabar*, and the *Ethiopic* oaſts, which from *Sofala* to *Brana* is very productive of am-ergris: It is alſo found in other countries, either as it may be riven very far into the ſea, and conſequently thrown out again pon the ſhore in various places of the earth, or as it may be et with in the ſeveral ways abovementioned.

'Tis worthy taking notice, that this precious bitumen is often und in very large pieces or lumps: But not to mention what *aber Lyncæus* relates from *Gregory de Bolivar*, that ſome-mes there are pieces of ambergris of 100,000 *lb.* weight; uch leſs what *Garcias ab Horto* tells us, that there are whole lands full of ambergris; nor what *Iſaac Vigny* a *Frenchman* lates, that he knew a country, ſo rich in ambergris, that a ouſand ſhips might be laden with it; all which ſeem to retch the point too much, eſpecially the latter; Dr. *Neuman* dduces the following inſtances, which may ſerve to ſhew that ere are really large pieces of ambergris.

In 1555 at Cape *Commorim* a piece was found of about oo *lb.* and which was then ſold for *Aſphaltum* or common itumen: *John Hugo de Lindſchot* relates that there was found bout this Cape a piece of 30 quintals, which is equal to 150 undred weight. *Monardes* and *Franciſcus Hernandez* make ention of pieces of 100 *lb.* weight; *Garcias ab Horto* ſpeaks pieces as big as a man; beſides a piece, that was 90 hands length and 18 in breadth: *Montanus* mentions a piece of 0 *lb.* weight, and kept by the king of *Satſuma* in 1659: In 666 about Cape *Verd* at the river *Gambi* a piece of 80 *lb.* eight was thrown out, which was brought to *Holland*: In 691 there was at *Amſterdam* a lump of 42 *lb.* *Daniel de ruel* affirms that about *Malacca* a piece was found of 33 *lb.* *Rome*, a piece as big as a man's head; and here and at *Lo-etto* and in other places in *Italy* are ſeveral valuable curioſities ambergris, which abundantly ſhew that they were wrought t of very large pieces: The abovementioned *Vigny* had no all piece, which he brought from *India*, and for which he

had 1300*lb.* ſterling; *Kæmpfer* relates that in his time there was found in *Kinokuni*, a province of *Japan*, a piece upwards of 100 *Catti* or 130 *Dutch lb.* weight: The two brothers *Joh. Andreas* and *Marcus Matſperger* of *Augsburg* bought of *Robert Struzzi* at *Venice* in 1613 a piece that weighed 48 *lb.* and 8 *oz.* And to mention no more, we have a very recent and withal ſtrong, inſtance in that large piece of ambergris, which the *Eaſt-India* company in *Holland* bought in 1693 of the king of *Tidor* for 11000 dollars; which was at firſt of the form of a tortoiſe and weighed 182 *lb.* was 5 foot 8 inches thick, and 2 foot 2 inches long: The above named *Nicolas Chevalier* has deſcribed it at large in a ſmall treatiſe publiſhed at *Amſterdam* in 1700, with various copper plates of it in different views: From all theſe inſtances we can no longer doubt but that there are pretty large pieces of ambergris; ſo that it may be queried, how the accounts from *America*, that mention a bag, can agree with lumps of ambergris of ſuch bulk?

An Account of a new Engine *for raiſing* Water; *by* Walter Churchman. Phil. Tranſ. N° 434. p. 402.

1. IN this engine the horſes or other animals draw horizontally in a ſtreight line and at right angles, whereby they exert their utmoſt force; by which means a far greater power is gain'd from the ſtrength of horſes, &c. than by their going round in a circle: For, by the twiſt and acuteneſs of the angles they draw in towards the centre, whereby they waſte their power, and likewiſe ſhorten their levers: Beſides, their muſcles and tendons from their hinder legs all along their ſides to their necks are unequally ſtrain'd, as the duty is hardeſt on one ſide even tho' their walk be large: Therefore, each of thoſe inconveniencies muſt be attended with pain to the animals when at work, and with a great loſs of their ſtrength.

2. A crank does not riſe quite ⅓ of its circle; neither do the regulators or rods riſe or fall perpendicular, but obliquely whereby an oval figure is formed by the piſtons motion in every cylinder, which occaſions great friction and a waſte of water, and every arm of it is continually varying in its power while working; as its lever is diſtant from the perpendicular line, and of the arms (ſuppoſing it a quadruple one) as they croſs the perpendicular, are always drawing to and from their own centre by which the power is not only loſt, but the time alſo. Farther, by the ſhortneſs of the ſtrokes, all the adjacent water is frequently mov'd contrarily, and by the often opening and ſhu-

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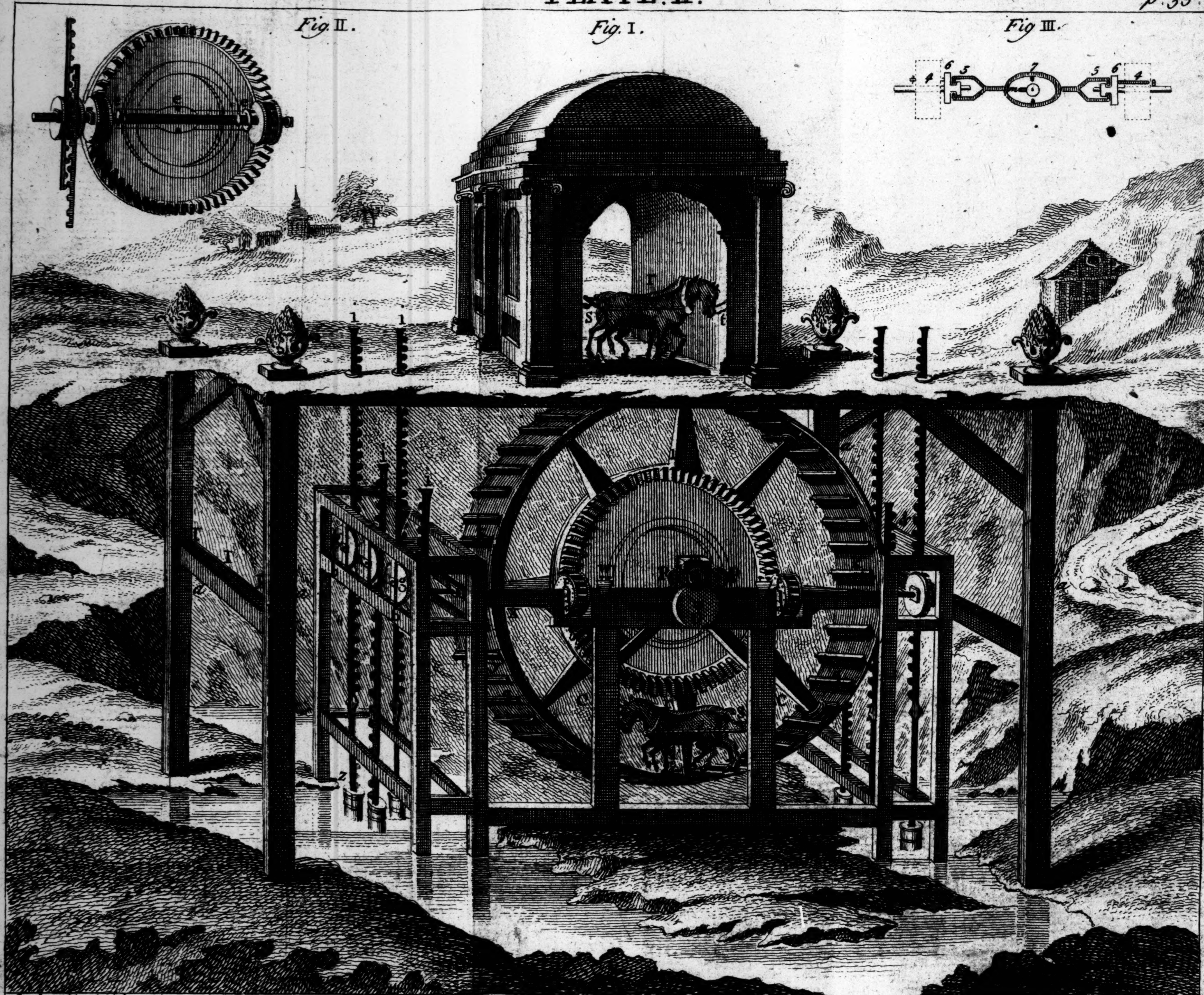

G. Smith del. Hulett Sculp

shutting of the valves, there is also a great waste of the water; besides the many heavy bearings, frictions, surges and repairs belonging to it; all which inconveniencies and impediments being thoroughly consider'd, there must certainly be requir'd a much greater power to work the same than by Mr. *Churchman*'s method. For, thereby a stroke of 24 feet will rise; and by enlarging or diminishing the fixed wallower, you obtain a stroke of any required height, even to the extent of the pressure of the atmosphere: By this great advantage, the water rises freer, and with greater velocity; and as the lifters or forcers rise and fall exactly perpendicular, and with an equal continued strain; and as the bearings also are fewer and lighter, consequently, the friction in all these will be a great deal less than with the crank, &c. And lastly, $\frac{7}{8}$ of that water which is always lost by the slow opening and shutting of the valves will be sav'd.

From the above considerations, and by the several experiments Mr. *Churchman* made on this occasion, in order to know the real difference between these different ways of working, he finds that near twice the quantity of water will be rais'd to the same height, in the same time, with the same power, by his method, than with the best crank-work that has hitherto been erected.

aaaa (Fig. 1. Plate II.) represents the great frame, the ends of which under the pine-apples are to be contracted to the place of the little frame; so that the cross piece at III may support the 3 bearings, now shewn in the little one, for a better view only; *bb* the little frame on which the cap-brasses are, which receive the turn'd gudgeons T in the 3 horizontal shafts; *cc* the strong supporters by the loose wallowers; *dd* the loose wallowers, whose turned rounds geer truly with the cogs in the great wheel; *eee* the regulator, (Fig. 2.) which has a circular, direct and retrograde motion; *ff* the strong shoulder or stud fixt to the shaft close by the wallower, which stops this loose wallower, when the end of the regulator comes against it, thereby confining it for 2 revolutions; after which it quits this stud, and does the same on the opposite side of the wheel; and so on alternately, to reverse the motion of the stems in the different cylinders; *gg* the wheels, with their cogs, which alternately work the fixt wallower lying between them; *h* the fixt wallower suppos'd to be 4 foot in diameter (on a very short shaft) whose rounds must be of cast soft iron, and truly turned, to elevate and depress the racks to the height of 24 feet by its 2 revolutions; *iiii* the 4 lifters or forcers, behind each of which

which muſt be a ſmall leverage back wheel, truly fitted to direct the ſame to riſe and fall eaſily and exactly perpendicular, to avoid friction and loſs of water in the cylinders; *k k* the large vertical wheel, a ſmall ſegment of which comes thro' the floor in the dome for the 4 horſes to ſtand and draw on; *l m* (Fig. 3.) the arms and the main ſhaft of the ſame; the arms lie horizontal and the oval part is perpendicular; *n* the turned T gudgeon, with its collar and ſhoulder, both of which muſt claſp the rim of the under leverage wheel, to keep all firm and ſteady when in working; *o* the leverage wheel about 4 feet in diameter, with a braſs or iron rim ſuppos'd to be truly turned, and to have a ſtrong ſhort iron ſpindle thro' its center, and at each end a turned ſteel collar and ſhoulder, bearing on 2 caſt cap-braſſes exactly level, and ſunk into a ſtrong arch'd piece of timber well braced and ſupported for this purpoſe. And here it is to be noted, that in large engines and machines where the motion is regular, every heavy bearing ſhould have one of theſe wheels: For, they ſave power by greatly abating friction. Upon the principle of theſe leverage-wheels Captain *Rowe* has publiſh'd what he calls his friction-wheels, tho' ſubſequent to Mr. *Churchman*'s ſpecification thereof; *p p* two ſmall ſide leverage wheels, exactly fitted to the turned part of the great gudgeon, between the collar and ſhoulder; they are to be placed and key'd in ſuch manner, that their friction from the gudgeon may be alike when at work; *q q* the ſteps which the horſes feet preſs, about 8 or 9 inches broad, 2 inches thick behind, and declining to an edge, being deſigned to make level ground, and good footing for their hinder legs when they draw; *r r* four horſes only in view to avoid confuſion, all drawing horizontally in a ſtreight line, and at right angles, whereby theſe uſeful animals will ſoon be taught a new and pleaſant way of working to themſelves, a more advantageous one to their maſters, and of greater utility to the public; *s* the faſtening places behind the horſes, ſuppos'd to be ſtrong arms below in the ſupporter, and a croſs bar above, at both which you may place ſmall ſheeves or rollers, the upper part of them to be level with each horſes breaſt (when drawing) and the rope or ſtrap to come over the ſame, in order to keep a weight of 300 *lb.* (more or leſs) ſuſpended, one or two inches from a plank. By this method you will be exactly informed of the ſtrength of each horſe, how long it continues, and when to relieve him; as alſo when juſtly to correct the ſlothful one, whoſe weight reſting on the plank will always diſcover his lazineſs; *t* the faſtening places before, which are deſign'd to direct

their

heir heads; *u* the dome meerly for ornament; instead of which erect a workloft, over that a horizontal windmil: On the lower end of its upright shaft fix a spur-wheel to work with the cogs of the great wheel, thereby to assist the horses, or when there is a sufficient force of wind to do their whole duty; *w* the coupling staples with the brasses; *x* the strong catch which confines the great wheel to the frame; *y* the screw or kay-band to confine all close and light; *z* the cylinders which are screw'd together at their ends out of sight; and all the same sort of work chiefly for uniformity in the draught.

An Abstract of Meteorological Diaries; *with Remarks thereon; by Dr.* Derham. Phil. Trans. N° 434. p. 405.

THE following meteorological observations were made at *Naples* by Dr. *Cyrillus*, at *Bengal* by Mr. *Bellamy*, and at *Christiana* in *Norway*, *by* —— communicated by M. *Kink*. *Ann.* 1727.

The following Tables of the barometrical and thermometrical observations are the more valuable, on account of their being made, as the Dr. supposes, with some of Mr. *Hauksbee*'s glasses.

The barometrical means at *Naples*, are both as they are set down by the illustrious observator himself, according to Dr. *Jurin*'s directions, and likewise as they are between the highest and lowest stations of every month: Those of *Norway* are in the latter way.

A Table *of the Barometrical Ranges at* Naples *and at* Christiana *in* Norway, *in the Year* 1727.

	JANUAR.		FEB.		MAR.		
	Naples.		Naples.		Naples.		Norw
High	29.80		29.88		30.6		29.3
Mean	29.55	29.65	29.63	29.72	29.59	29.73	29.1½
Low	29.30		29.38		29.12		29.0

	APRIL.		MAY.		JUNE.		
	Naples.		Naples.		Naples.		Norw
High	29.88		29.88		29.72		29.3
Mean	29.63	29.72	29.71	29.73	29.60	29 6+	29.1½
Low	29.54		29.54		29.46		29.0

The

The Table *continued.*

	July.			August.			Sept.	
	Naples.		Norw.	Naples.		Norw.	Naples.	
High	29.80		29.7	29.80		29.7	29.88	
Mean	29.67	29.70	29.3½	29.55	29.63	29.5	29.59	29.72
Low	29.54		29.0	29.30		29.3	29.30	

	October.		Novem.		Decemb.	
	Naples.		Naples.		Naples.	
High	29.88		30.06		29.88	
Mean	29.50	29.66	29.59	29.75	29.59	29.65
Low	29.12		29.12		29.30	

A Table *of the Thermometrical Ranges at* Naples, Beng *and* Chriſtiana *in the Year* 1727.

	Jan.	Feb.	March.		April.		May.	
	Nap	Nap.	Nap.	Beng.	Nap.	Beng.	Nap.	Beng
High	51.3	44.5	48.3	15.2	41.0	15.3	30.0	20.4
Mean	47.1	40.0	41.0	7.6	31.0	7.9	24.0	10.6
Low	43.0	35.0	34.5	0.1	21.0	0.6	18.0	0.7

	June.			July.		
	Nap.	Beng.	Chriſt.	Nap.	Beng.	Chriſt.
High	20.0	10.8	46	17.0	15.4	4
Mean	14.7	5.8	37	10.0	7.7	3
Low	9.5	0.8	29	3.0	0.1	30

	August.			Sep.		Oct.	Nov.	Dec
	Nap.	Beng.	Chriſt.	Nap.	Beng.	Nap	Nap.	Nap.
High	21.0	15.4	45	25.0	10.4	43.5	47.0	50.5
Mean	11.1	7.8	35	19.7	7.7	32.2	43.7	43.2
Low	7.3	0.2	25	14.5	5.0	21.0	40.5	36.0

Theſe tables give an eaſy view of the barometer and th mometer in the ſeveral diſtant parts of the world ſpecified

whi

which would have been very instructive, had they been obſerv'd throughout the year, as they were at *Naples*.

By the barometrical obſervations it appears, that the aſcent and deſcent of the mercury is not ſo great at *Naples*, as in the more northerly climates: For, it was but twice in the whole year above 30 inches; and but thrice as low as 29.12 inches. And ſo in *Phil. Tranſ.* N° 321. Dr. *Derham* obſerved, that at *Zurich* the range is but about an inch; but at *Upminſter* he finds the higheſt aſcent to have been 30.44 inches and the loweſt deſcent 27.44 inches, which is a range of 2 inches and ½: And by his account of the *Petersburg* obſervations in 1724. *Phil. Tranſ.* N° 424. p. 107. it appears that the mercurial range there is 3.31 inches: And as to *Norway*, the obſervations are too few, and all made only in the ſummer months, whereby no good judgment could be form'd: And at *Bengal* they had no barometer.

By the thermometrical table we may judge of the heat and cold of the ſeveral places: For the right underſtanding of which, it is to be noted, that in Mr. *Hauksbee*'s thermometers, the point of extreme heat is 5 degrees above 0; the point of temperate 45 degrees below 0; and the point of freezing 65 degrees. But Dr. *Cyrillus* ſaith, it freezes with them at *Naples*, when the ſpirits are only got to 55 degrees. His words, which are to the following purpoſe, are remarkable: 'I take it to be 'worthy of your ſagacity, and your ſtudy of nature, to account 'how it comes to paſs, that with us water freezes when the ſpi-'rits in the thermometer are ſcarcely fallen to 55 degrees; 'whereas at *London*, not before they are at 65 degrees, where 'your point of froſt is marked. And if our Philoſophy can 'avail us any thing, it ſhould ſeem that there is ſomething or 'other requiſite, with which our air is impregnated, and yours 'not, beſides an intenſe degree of cold to congeal water, as in 'artificial freezing, not ſnow alone, but ſuch as is mixed with 'ſalt, is to be employed.

And as it freezes at *Naples* at a warmer degree of the thermometer; ſo Dr. *Derham* obſerves, that at *Chriſtiana*, the illuſtrious obſerver complains of the *vehement heat of the ſun in July*, when the ſpirits were but at 36 and 34 degrees: In *Auguſt* at 25, 27, and 28 degrees, when he ſays *the weather was exceeding hot*. The Dr. thus diſtinctly mentions (as the author doth) *the heat of the ſun*, and *the heat of the weather*; becauſe they may not mean the ſame thing, he having been informed by the whale fiſhers, that in *Greenland* the heat of the ſun is ſcarce

tolerable on one side of the ship, when on the other it freezes hard.

At *Bengal* the heat at sometimes seems to be very intense, by the thermometer being in some months more degrees above 0, than the point of extreme heat is: As particularly in *April*, *May*, and *June*, it was 6, 7, and 8 degrees above 0. But those excessive heats are commonly in the afternoons, the forenoons being more temperate; and the temperature, or what they call cold there, is at the same time of the day: And the degree of the thermometer, at which they reckon it coldish, is about 15 degrees. And on *May* 2. at 8 o'clock in the morning Mr. *Bellamy* saith, (the thermometer being then at 20.4 degrees) *the morning was like winter weather in* Europe.

Whether this so different judgment of great cold at *Bengal*, when the thermometer was about 20 degrees, and of excessive heat at *Christiana*, when it was but a little below that, *viz.* at 25 degrees, &c. Whether it arises from some prejudice, or from some extraordinary quality in the air, Dr. *Derham* leaves, as Dr. *Cyrillus* doth, to others to determine.

As to the weather, winds, rain, &c. of the several places Dr. *Derham* only gives a transient view of every month.

At *Naples*, *January* was a cool month, frequent rain with much thunder and storms of wind. The rain amounted to 111 measures and ½ (23 of which make an *English* inch in depth) which is 4 inches, 19 measures and ½, or near five inches. *Vesuvius* was pretty quiet.

February was a drier month, the rain amounting only to 14 measures, which is but a little above ½ an inch deep. The weather was for the most part cloudy, with some frosts. *Vesuvius* emitted a thick smoke.

At *Naples*, in *March* it was cold, with hail and snow on the mountains; the rain amounted to 101 measures, which makes 4 inches, 9 measures depth. The winds were in all the points. *Vesuvius* discharged rivulets of fire.

At *Bengal*, the 5 last days of *March* (which were all observed in this month) were fair, the wind S2.

In *April* the winds at *Naples* were much in the northerly points, cold, frequent thunder, the rain only 38 measures, which make 1 inch, 15 measures. There was no fire in *Vesuvius* the beginning of the month, but towards the latter end, divers rivers of fire and smoke.

At *Bengal* the wind was much among the southerly points, cloudy, some rain and thunder. The weather for the most part temperate, but great heats in the afternoons.

In

In *May* at *Naples*, the wind lay much in the westerly and utherly points. Rain 103 measures and $\frac{1}{2}$, which make 4 ches 11 measures and $\frac{1}{2}$ in depth, with frequent thunder. *esuvius* cast out rivers of fire, which reach'd almost to the ottom of the mountain.

At *Bengal* the winds varying, but for the most part souther-, with much cloudy, rain and thunder. The beginning of e month colder than ordinary; afterwards exceeding hot.

In *June*, at *Naples*, the wind was much in the westerly and orth westerly points, but little rain, only 6 measures and $\frac{1}{2}$, hich is but about $\frac{1}{4}$ of an inch depth.

At *Bengal* much rain, with thunder and heat. On *June* h it is noted; 'we are now pretty certain the rains are set in.'

At *Christiana*, the observations begin on *June* 22, the wea-er temperate, and for the most part cloudy, with thunder, hail, d rain.

At *Naples* *July* was a hot dry month; without any rain, but equent mists. *Vesuvius* quiet.

At *Bengal*, there was frequent and much rain, with thunder d lightning; for the most part cloudy; winds perpetually rying.

At *Christiana* great rains with thunder, frequent fogs, some ir, and complaints of vehement heat; tho' the thermometer as but at 30 degrees in that month.

In *August*, at *Naples* the wind was in the westerly and north-esterly points, showers with thunder were frequent, which nounted only to 49 measures and $\frac{1}{2}$, which is but a little above inches depth. And tho' by the table the weather seems to ve been warm; yet there are frequent complaints of the air ing cold. *Vesuvius* cast forth a large river of fire.

At *Bengal*, much rain, with thunder and cloudy, winds va-ing, but pretty much easterly; weather sometimes very hot, t for the most part more temperate than in some of the other onths.

At *Christiana*, the wind various; frequent mists with clou-, and sometimes fair, and sometimes rain. Great complaints heat, tho' no great signs of it by the thermometer.

In *September*, at *Naples*, the winds various and very stormy wards the latter end of the month, with horrible thunder, htning, and heavy rain, which amounted to 220 measures d $\frac{1}{2}$, making 9 inches 13 measures and $\frac{1}{2}$ in depth; which is ore than fell in any month this year, and drown'd the marshes, d did a great deal of damage to houses, trees, &c. *Vesuvius* s quiet at the beginning, but fiery at the end.

Bengal hath only the 7 firſt days obſervations, where th
wind was moſtly eaſterly, cloudy and ſhowery, with thund
and lightning.

The obſervations of the remaining months are all of *Naples*
where in *October*, the wind was various, and ſometimes ſto
my, with thunder; frequent miſts, and ſometimes heavy rai
amounting to 107 meaſures, which is 4 inches 15 meaſures, an
in the mountains, ſnow. *Veſuvius* was turbulent in the begin
ning of the month, and emitted a river of fire.

November was, for the moſt part, a cloudy miſling mont
with thunder and rain; but of no greater quantity than 73 me
ſures, which are equal to three inches 4 meaſures depth *Eng
liſh*. Then the wind was more northerly than in any oth
quarter. The fire of *Veſuvius* leſs.

December was a wet, ſeaſonable month, the rain being 17
meaſures, which is 7 inches 18 meaſures in depth; and this u
on the rains and unſeaſonable weather of the preceeding mont
greatly damaged the fruits of the earth. The rain of the who
year the illuſtrious obſerver computes at 3 *Engliſh* feet 7 inch
and 14 $\frac{1}{2}$ meaſures: And to ſhow how much wetter this ye
was than theſe other, he gives theſe quantities of the year 17
2 *Engliſh* foot 10 inches, 14 meaſures: Of 1725, 2 foot
inches, 17 meaſures: Of 1726, 1 foot, 11 inches, 14 $\frac{1}{2}$ me
ſures

The dead bodies of a Man and Woman preſerved for 49 *yea
in the Moors in* Derbyſhire, *by Dr.* Charles Balguy. Ph
Tranſ. N° 434. p. 413.

THESE two perſons were loſt in a great ſtorm of ſno
on the moors, in the pariſh of *Hope*, near the woo
lands in *Derbyſhire* on *Jan.* 14. 1674; and not being fou
till the 3d of *May* following, they then ſmelt ſo ſtrong, t
the coroner ordered them to be buried on the ſpot: They l
in the peat-moſs for 28 years and 9 months before they w
look'd at again; when ſome countrymen, having obſerv'd t
extraordinary quality of this ſoil in preſerving dead bod
from corruption, were curious enough to open the Ground, to
if theſe perſons had been ſo preſerved, and they found them
way alter'd, the colour of their skin being fair and natural,
their fleſh ſoft, as that of perſons newly dead: They were
wards expoſed for 20 years, tho' they were much changed
that time, by being ſo often uncover'd: And in 1716 th
condition was as follows: The man was perfect, his beard ſtr

d about $\frac{3}{4}$ of an inch in length; the hair of his head ſhort, his in hard, and of the colour of tanned leather, which is nearly at of the liquor and earth they lay in: The woman being ken out of the ground, had one leg off, the fleſh decay'd, and e bone ſound; the fleſh of one hand decay'd and the bone und; the upper lip and the tip of her noſe decay'd, but no her part of her face: Her hair was long and ſpringy, as that a living perſon: The upper part of one of her foreteeth, as r as was contained in the ſocket, was as elaſtic as a piece of eel; and wrapt round the finger, it would ſpring again to its ſt form: But it loſt this power after it had been kept for a w minutes in the pocket: They were afterwards buried in *Hope* Church, where viewing them ſome time after, they were und entirely conſumed.

They had lain about a yard deep in the ſoil or moiſt oſs, but without any water in the place: The man's legs, hich had never been uncover'd till now he was buried, ere quite fair; the fleſh, when preſſed with the finger, itted a little, and the joints play'd freely, and without the leaſt iffneſs: The other parts were much decay'd: What was ft of their cloaths, (for the greateſt part of them had been cut way, to carry home as a curioſity) was firm and good: The oman had on a piece of new ſerge, which ſeemed never the orſe.

he ſequel of the Account of Ambergreaſe *by Dr.* Neuman. Phil. Tranſ. N°. 435. p. 417. *tranſlated from the* Latin.

AS to outward appearance, there are ſeveral ſorts of ambergreaſe, as aſh-colour'd, whitiſh, yellowiſh, of a dark aſh olour, and ſmooth, as if done over with leather, red, veiny, ſpotted, and entirely blackiſh, both that ſwallowed by animals and fterwards either ejected into the ſea, or found in their bodies, as hat which was not ſwallowed. The ambergreaſe, that has een ſwallowed, is both the baſeſt and leaſt valuable; for, it enerally retains ſomething of the place, from which it was aken, or ſome animal fœtor, and conſequently is eaſily diſtinguiſhable from good ambergreaſe: So likewiſe, that ſort, hich is entirely blackiſh, or whitiſh, is of no great value: n like manner, what appears ſmooth, uniform, and too pure o the eye, is to be ſuſpected, as rarely genuine, and generally dulterated, if not entirely factitious and compounded. On the ontrary, what appears aſh-colour'd, veiny, or even ſpotted hite, black, or yellow, coated over with an external blackiſh cruſt;

cruſt, tho' not ſo very pure, but mixt here and there with the becks of birds, parts of the cuttle-fiſh, the ſpines of fiſhes or other matters, yet for all this it is reckoned the beſt: Tho' the admixture of theſe impurities be not always ſo neceſſary, but that, if it can be had, it may be choſe rather pure than impure; the Dr. only mentions this, to ſhew that the beſt ſort is generally mix'd with variety of traſh.

The primary properties of good ambergris, beſides thoſe already mentioned, are the following; that it be light, and feel almoſt like wax, and at the ſame time be friable, yet a little tough, ſo that in pounding, it may ſtick to the mortar or peſtle, be of a fragrant ſmell, eaſily take fire at a burning candle, and conſtantly preſerve its flame, eaſily melt over the fire or a live coal, and have no particular taſte, neither bitter nor auſtere, neither acid nor ſaline.

The common way of trying the genuineneſs of ambergris, is (to prevent waſting much of it) to prick it with a needle, or other fine inſtrument, made red hot; and then ſomething like melted roſin ſhould appear about the needle and riſe up: Or it is thrown on live coals, or a little of it is melted in a ſilver ladle over a burning candle: This proof, it is true, has its uſe; but if you cannot accurately diſtinguiſh the exhaling odour, and beſides, obſerve the various other circumſtances, and only attend to its melting, even this common proof may fail, and it may equally hold in adulterated, nay in factitious ambergris; as does alſo that other recommended by *Etmuller*; *viz.* that genuine ambergris ſoftens between the fingers like wax, whereas the factitious is friable; a property that may be eaſily given it by art, and which is neither conſtant nor univerſal.

Ambergris is adulterated, nay even compounded by impoſtors, with wax, roſin, ſtorax, benjamin, amber, *ladanum*, muſk, civet, aloes, the rottenneſs of the aſh-tree, the flower of rice, the moſs of trees, *&c.* According as one cheat improves upon another, in a juſter proportion and mixture of theſe ingredients; but the trick is eaſily diſcovered.

1. The factitious and compounded ambergris appears generally quite uniform, and every where of the ſame colour and mixture, like a maſs of pills or like dough; a thing that never ſo equally holds in natural ambergris. 2. Such counterfeit ambergris generally ſoftens ſooner in a warm hand than the genuine. 3. But the beſt way of diſcovering ſuch factitious ambergris is by the ſmell; for, as the true ſmell of ambergris is entirely

ely peculiar, so it cannot be so easily imitated by art, but t this or the other smell from the ingredients shall sometimes edominate, and so the cheat be discovered; and that the ore easily, if you strew it on live coals, or melt it in a fil- r ladle over a burning candle, or even a bit of it be held the naked flame, and you snuff its fume, and also attend its melting and taking fire: If it be genuine, it will then il in melting, continue brown after melting, and at last dif- e an amber odour, tho' weaker than common amber: But it be counterfeit, it will fail in these properties more or s: For, this latter will either not melt at all, or later or ich sooner: In boiling and in its odour it will be different; it will either yield a something fetid, or more fragrant ell, or an entirely different smell from the fumes of true bergris: And then after toasting and boiling, it will not tinue of the same appearance as true ambergris, but be e a coal, ashes or earth, and consequently exhibit a quite ferent appearance, even in respect of colour. 4. Should h adulterated ambergris occur as had no foreign smell, l which notwithstanding happened to be compounded with nething inodorous, as the moss of trees, and consequently uld have no other scent than that of true ambergris, even h a cheat shall be easily discover'd: For, ambergris in s proportion shall smell too sparingly or weaker; and own on live coals it shall fume more copiously, if not sen- y stink; nor will it melt equally all over, nor in melting, l as the genuine sort does; in fine, it shall not be so easily dled in the flame of a candle, nor burn incessantly till it spent like a small candle, which yet genuine ambergris s. 5. Moreover, all factitious or adulterated ambergris solution shall appear quite different from the genuine. And lastly, in distillation in an open fire the counterfeit fers greatly; not to mention other proofs at present.

Genuine ambergris, therefore, is a bitumen, and among all known species of bitumens it equals or comes nearest to ber, excepting in its hardness and transparency: It comes rest to it in its composition, not only beyond the other bi- nens, and all other minerals, but beyond all other things nature of what denomination soever they may be, as shall ear farther on.

Tho' the term bitumen denote nothing other than some eral mixt, yet most writers of natural history have con- d it to this specific meaning, that such a mixt is properly a

clammy

clammy fat of the earth, which eaſily burns; and this cha
racter perfectly agrees with ambergris: For, a fat or oil co
ſtitutes the baſis or bulk of its eſſential parts, and one drach
thereof holds at leaſt 2 ſcruples and $\frac{1}{2}$ or $\frac{5}{8}$ parts of oil; o
which account ambergris may not improperly be called
fat: But as this fat or oil in ambergris is neither a vegetab
nor animal, but plainly a mineral oil, it may hence with t
greateſt propriety be called *a fat of the earth*: That amb
gris is a clammy body or clammy fat in reſpect of other
cannot be queſtioned, otherwiſe it might be eaſily ground a
powdered, and not ſtick in ſuch a manner to the peſtle a
mortar: In fine, that it readily takes flame, may be eaſ
ſhewn, if you apply a bit of ambergris to a burning candl
conſequently it has all the requiſites and characteriſtics of
bitumen.

That ambergris approaches neareſt to amber of any ſu
ject, Dr. *Neuman* had learned by experience: For, 1. Amb
gris by itſelf, and in a dry form, melted over a naked fi
conſequently gradually exhaling, and alſo on a live coal, l
a ſtrong amber ſcent; but if ambergris be with water co
mitted to the fire, it will then in like manner melt like ro
and give the water in ſome meaſure an amber flavour, tho
does not mix with it; and this flavour is alſo eaſily taken
by diſtillation; but the ſurrounding moiſture prevents both
reſolution of the mixt and the evaporating of ſome eſſen
particles; in a word, the amber ſmell does not this way
diſcover itſelf, as when it is melted dry. 2. Ambergris,
the preparation of varniſh, differs not from amber; if amb
gris be melted, and dephlegmated lintſeed-oil be afterwa
poured to it, or other ſomewhat oleaginous varniſhes
mixed with it. 3. And laſtly, the moſt convincing expe
ment is the diſtillation of ambergris in an open fire; for,
this proceſs every circumſtance perfectly and nearly coinci
as in that for amber: Dr. *Herman Nicolaus Grimm*, who
been for a long time in the *Eaſt-Indies*, gradually diſtilled
a glaſs retort in an open fire an ounce of ambergris;
there came over firſt, a phlegm, then a ſpirit, and the
yellow oil and a little volatile ſalt; and there remained
the retort ſomething like pitch; and he plainly tells us,
the phlegm, oil, ſalt and remainder, had the ſame appe
ance, the ſame properties, as theſe very parts have in
diſtillation of amber, only that the oil diffuſed a ſomew
more fragrant ſmell, *Ephemer. Nat. Curioſ. Dec.* II. *An*
p.

405. Dr. *Neuman* imitated this experiment on a drachm ambergris, and found the very ſame things, with this only fference, that in his proceſs, he had got no conſiſtent re-inder, but a little powder not exceeding a grain in weight; ich neither affects the thing itſelf, nor Dr. *Grimm*'s expe-nent; but the difference was probably owing to this, that finiſhed his proceſs a little ſooner, or at the laſt did not ap- a ſufficiently ſtrong fire; for, in this caſe we obtain ſuch a nainder; and conſequently Dr. *Neuman* found that the ole body of ambergris may in a conſtant, violent degree fire be diſtilled and brought over; and moreover, he alſo tained from a drachm of ambergris 2 ſcruples and ½ of oil, *gr.* of water, 2 *gr.* of ſalt, and about a grain weight of wder; the other two grains were loſt by partly adhering to e ſides of the retort and by partly evaporating: The oil d ſalt, as being the two principal parts, were of the ſame ture, as thoſe of amber, conſequently, not urino-volatile: om this proportion of its ingredients we may reflect that ſo all a quantity of ſalt and earth is however capable of con-nſing a much greater portion of oleaginous parts, or of re-cing them to a firm, tenacious and entirely dry ſtate; alſo, at this circumſtance in a greater meaſure agrees with am-r, and conſequently confirms its affinity even in this reſpect: ll ſpecies of ambergris do not ſeparate any pure ſalt, ſince at little it has is eaſily intangled in a copious oil.

Since, therefore, this precious matter, ambergris, exerts its incipal virtue by its fragrancy; hence it has been uſed r a long time in perfuming; as in balſams, ſnuffs, dentifrices nd electuaries for the teeth, powder for the hair, waſh-balls nd in perfuming clothes; and conſequently, rather applied for licacy than uſefulneſs: Since likewiſe a variety of medicinal ualities was formerly aſcribed to ambergris, as a cardiac, phalic, apoplectic, bezoardic, nervine, &c. Hence it was ed in the ſhops, tho' formerly in greater plenty than now, different preparations and compoſitions, yet more in the alenical than chemical ones, and commonly in the form of a owder. But to wave theſe, and mention one only inſtance of very common preparation ſtill in uſe; *viz.* the ſimple eſ-nce of ambergris; in which there is nothing other than pure mbergris with its menſtruum; and the rather as in the ſo-ution of it, he obſerved one or two circumſtances, not to be et with in any author.

It has hitherto been received as a certain truth, that recti-fied spirit of wine does not of itself dissolve ambergris; and from this authors concluded that ambergris was neither vege-table nor animal; neither a rosin, nor an oleaginous fatty or resinous body, but a bituminous mineral; because rectified spirit of wine affects it very little, much less dissolves it; and only in the same manner as it affects asphaltum, amber and other bituminous mixts; from which indeed it may ex-tract a little, but never make a perfect solution: And even Dr. *Hoffman* himself, *Observat. Physic. Chym. Select. Lib.* I. *Observ. XVIII. p.* 67, *&c.* affirms that 'the solution and ex-'traction of all resinous bodies are easily performable in 'highly rectified spirit of wine; but, which is remarkable, 'he says, that this does not hold in ambergris, which is of 'very difficult solution in this spirit: And because we observe 'that inflammable bodies, which grow out of the earth, as 'amber, jewish pitch, pit-coal, are also of more difficult so-'lution, nor so readily mix with a highly spirituous liquor; 'hence it is we give in to those, who hold that ambergris is 'referable to bitumens, whose origin is from the earth, *&c.*' And further he says; 'since ambergris therefore is of so diffi-'cult a solution, this undoubtedly is the reason that we have 'no genuine solution of it in the shops: For, generally they 'are wont to prepare it with musk, the essential oils of cin-'namon and other oils, or even with civet; and thus indeed 'we are possessed of a very fragrant essence, and which is 'not without its virtue and use; but it partakes but little of 'the ambergris, which latter remains rather untouch'd.' But Dr. *Neuman* has from his experience shewn this solution in spirit of wine, not only possible but easy, and it requires only some little management: Take highly rectified tartari-sed spirit of wine (tho' in case of necessity, the simple recti-fied spirit without tartar may equally answer) and put to it $\frac{1}{12}$ part of pure, genuine ambergris cut small; put it in such digestion, as gradually heats, so that the spirit or menstruum begin to boil; and this is all the art: Then a perfect solu-tion ensues; for, he dissolved 2 scruples of ambergris in an ounce of spirits, and there remained undissolved in the bot-tom of the glass, that impurity only, which was not amber-gris, but consists of earthy and other heterogeneous parts, sometimes 2 grains, or only one grain in weight: For an ex-temporaneous proof of this; set a glass, which is not quite filled, nor closely stopped, for fear of its bursting, over live

coals

oals or a burning candle; and the experiment succeeds, as on as the spirits begin to boil: But if we use an inflammale oleaginous spirit as the menstruum, whether drawn over ne or more oleaginous vegetable, or whether some essential l be dropped into such highly rectified spirit of wine, then e solution succeeds the sooner; and for the rest, neither spi- of roses, nor any other spirit, which is drawn over, un- s it be rich in oil, or impregnated with oleaginous particles, s here, with respect to the power of the solvent, any pre- rence to highly rectified spirit of wine.

The following circumstances are remarkable. 1. That if ghly rectified, simple spirit of wine without *alcali*, or even rtarised spirit of wine, newly drawn over salt of tartar, be ken; then indeed in the aforesaid proportion there is also a mpleat solution; but this solution or essence of ambergris, it is called, is not sufficiently deep or high coloured. The remainder is apparently no inconsiderable quantity, that the greatest, or a considerable part of the ambergris pears indissolved; tho' really, upon filtring the solution, d drying and weighing what remains in the filtre, it prove ry little in quantity, and is a pure powder or tender earth, ovided the genuine ambergris be used. 3. If the spirit be t sufficiently dephlegmated, or a sufficient degree of heat not applied; in that case, there is either no solution at all, a bare and simple extraction only. 4. But if you use for e solution such tartarised spirit of wine, as has only stood infusion with salt of tartar, without afterwards drawing it er, then the solution is sooner and better tinged.

From these four circumstances, therefore, arise the following nsectaries. 1. Since generally in the essence of ambergris, its colour or tincture is also sought for, many perhaps have t taken it for a solution, because it appeared but little ged. 2. And that the less, as they observed so apparently pious remains; which at first made the Dr. himself think, re was little or no solution, till he had dried and weighed when he found it not only very small in quantity, but a re heterogeneous powder, that made no part of the solu- n or essence of ambergris. 3. Or if this solution has not cceeded to any one's mind; in that case, the spirits were t sufficiently rectified, or a due degree of heat was not ap- ed; and probably many have thought, that as ambergris s a fragrant matter, if either digested or infused in a strong

heat, its beſt and moſt ſubtile parts would evaporate, an therefore a gentle degree of heat was to be applied; tho indeed all ſorts of ambergris do not require ſuch a vehemen fire, and yet the ſolution ſucceed. 4. And laſtly, it follow that if you either obtain or have a highly tinctured eſſenc and beſides the menſtruum, you uſe nothing other than am bergris, ſuch menſtruum is always a ſpirit of wine tartariſe by infuſion; whence the tincture originally proceeds, no from the ambergris, but from the fixt alcaline ſalt, and only heightened by the oleaginous parts of the ambergri The certainty of this circumſtance appears, if highly recti fied, oleaginous ſpirit, of wine, be digeſted *per ſe* with ſalt tartar only; for, hence ariſes a ruddy tincture, called tin ture of tartar: If this ſpirit of wine be not oleaginous; ne ther the tincture of tartar will be ſo beautiful, and ſcarce tinged yellow, or it will be entirely without any tincture but if you put to it a drop or two of eſſential oil, as *aniſe*, you will plainly ſee a more ſaturated tincture.

The concluſion of this matter is, therefore, this: 1. Th if ambergris be treated with pure and highly rectified ſpi of wine, or even with ſuch as is tartariſed by drawing over; then indeed there is a compleat ſolution, but witho any peculiar tincture. 2. But if the ſame ambergris treated in the ſame manner with ſpirit of wine tartariſed infuſion; that then there is not only a ſolution, but alſo tincture, which is chiefly owing to the ſalt of tartar, and co ſequently in reſpect of colour is rather to be conſider'd a tincture of tartar. 3. But if it appears a little higher c loured than tincture of tartar, in that caſe the oily parts the amber have in like manner contributed to the heighteni the tincture, as if you had put one or more drops of anoth oil to another tincture of tartar, to which no ambergris w uſed. 4. If, therefore, the alcaliſate ſpirit of roſes, ma either by fermentation or even by repeatedly drawing it o roſes, be applied as a ſolvent in the preparation of eſſence ambergris, and with it an excellent eſſence be prepared, are not hence to conclude, as if ſpirit of roſes alone were peculiar and appropriated ſolvent of ambergris: For he as was already ſaid, there is ſome alcaline ſalt, as alſo ſo oleaginous parts; and from theſe the tincture ariſes in ſame manner, as if tincture of tartar were prepared fr ſalt of tartar with oleaginous ſpirit of wine, without a bergris and without roſes; and the ſolution of amber

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ways proceeds, as if it were a ſolution with another tariſed ſpirit of wine, or even with what is highly rectified d ſimple, without ſalt of tartar.

But that the eſſence or ſolution of ambergreaſe, prepared in proper manner with good ſpirit of roſes, diffuſes a much onger and more grateful odour, than that prepared with nple ſpirit of wine, is entirely natural. For, 1. Spirit of ſes *per ſe*, has not only a ſtrong but a fragrant odour, whereas e ſimple ſpirit of wine has almoſt none at all: 2. It is known at ambergreaſe is naturally diſpoſed not to yield any peculiar lour; but ſo ſoon as ſome other thing, naturally fragrant mixed therewith; that then the odour and fragrancy of nbergreaſe is, as it were, rouſed, excited, and really exted; and this is the caſe in the ſolution of ambergreaſe with irits of roſes.

The officinal eſſence of ambergreaſe may, therefore, not improperly be prepared with alcaliſate ſpirit of roſes on the account of heightening the odour; but as there are many, who nnot bear either the ſmell or taſte of roſes, hence it will be oper to prepare this eſſence with highly rectified and alcalite ſpirit of wine: But that this tincture may be ſufficiently ficacious, and the ſolution the ſooner accompliſh'd, and not ithout its colour, it will be proper doubly to alcaliſate the lvent or ſpirit of wine; as firſt prepare a pretty good tartaiſed ſpirit of wine by drawing it over, or let a genuine highly ectified ſpirit of wine be ſeveral times diſtill'd on a fixt alcaline lt; and let it be again returned on pure and calcined fix'd alaline ſalt, and digeſted for ſome time; at length decant it, and ſe it as a ſolvent for the eſſence or ſolution of ambergreaſe; and hen this ſpirit, in reſpect of its ſolutive virtue, will act in the ame manner as the beſt and moſt precious ſpirit of roſes; nay f the ſpirit of roſes was neither tartariſed nor alcaliſate, it will ender the preference doubtful.

Etmuller ſomewhere writes, *opera Pharm. Chym. in Schrodero dilucid. p. 79.* that 'ambergreaſe is made to ferment with roſes, and hence the *ſpiritus roſarum ambratus* may be made, which is to be preferred to pearls, as the greateſt cardiac and comforter': But ſince water, as the common ſolvent of bodies that are to be fermented, does not in the leaſt touch ambergreaſe; and that a true fermentation cannot poſſibly happen to roſes on the part of ambergreaſe; it is probable this is a miſtake of *Etmuller*'s; into which he was led by being told, that a grateful ſpirit is

made

made with ambergreaſe and ſpirits of roſes well ferment[ed] and rectified: That the fragrant ſpirit of roſes, even witho[ut] ambergris, is preferable to pearls, only on account of its fr[a]grancy, is not to be doubted; for, as a cardiac Dr. *Neum[an]* prefers crabs-eyes, nay common oiſter-ſhells to pearls; but th[is] by the bye.

It now only remains to prove that an inflammable oleagino[us] ſpirit promotes the ſolution of ambergreaſe, as may be ſhew[n] to the eye: Take highly rectified inflammable ſpirit, and thro[w] into it bits of ambergris; if you obſerve them not to diſſolve, then pour in a few drops only of any pure, eſſential, diſtilled oil, free of all expreſſed oil, and the experiment manifeſtly ſucceeds in a ſhort time: The reaſon is, that ſuch oils are ſolvent[s] of ambergreaſe; ſince the experiment always ſucceeded no[t] only with the various aromatic, fragrant, eſſential oils, as with that of mint, lavender, &c. but with the *Italian Oglio di cedro*, with the reſinous oil of terpentine, as alſo with the pure rectified, bituminous, oil of amber, which is of the ſame famil[y] with itſelf, whereas with expreſſed oil, as that of almond[s] there was not the leaſt ſolution or extraction; from which i[t] appears the more evidently that *Schroder*'s eſſence of ambe[r]greaſe, by firſt digeſting and expreſſing the ambergreaſe wit[h] oil of almonds, and afterwards drawing highly rectified ſpiri[t] of wine over what is thus expreſſed, rather hinders than promotes a ſolution.

Dr. *Neuman*, with a view to the ſolution of ambergreaſe made trials with dulcified ſpirits, both alcaline and acid; an[d] he infuſed and digeſted it with the dulcified ſpirit of vitriol, nitre, and ſalt; as alſo with dulcified alcaline ſpirits, as o[f] urine, or the vinous ſpirit of ſal-ammoniac, as it is called, wit[h] quick lime, and prepared ſalt of tartar; but theſe extracted little or nothing, and would not entirely diſſolve it: In the infuſion with dulcified ſpirit of vitriol there happened ſomething ſingular; this ſpirit, with the little it extracted, form'd ſome ſaline grains, which ſettled to the ſide of the glaſs wherein the infuſion was made.

That white viſcid matter, of the appearance of tallow, which is commonly wont to precipitate from the ſolution or eſſence of ambergreaſe; M. *Lemery* takes to be wax; and from this circumſtance he would prove, that ambergreaſe is nothing other than wax.

But if this white matter happen to ſeparate, then in that caſe the Dr. commonly obſerv'd the three following circumſtances abou[t]

ut it, which if they are not conjointly abſolutely requiſite
he precipitation, yet at leaſt one of them is ſo for either the
nce or ſolution as ſtood in a glaſs that was not quite full, but
f or a third part empty; or the glaſs has not been ſtopt ſo
ht but that the moſt ſubtle ſpirits have inſenſibly exhaled;
therefore in proportion to that exhalation a little of the ſo-
ion is again precipitated; laſtly, the ſolution has ſtill ſtood
r ſome part of the indiſſolved ambergreaſe. For if the ſolu-
be immediately decanted from its remainder, and a glaſs
quite fill'd up with it, and ſtopt very tight, to prevent its
porating, then none of it precipitates ſo ſoon, nor does any ſuch
itiſh matter appear; conſequently the evaporation of this
ſubtile ſpirit is the true and principal cauſe, that it again
ipitates in its flight what it held before diſſolved.

. The whitiſh matter which M. *Lemery* takes for wax, is
hing other than a ſort of depurated, or reduced perfect am-
greaſe; which appears from treating the whitiſh matter
the ſame manner as the ambergreaſe was before with
hly rectified ſpirits of wine or any other ſolvent made
of for the latter; whereas if the trial be made with
, and highly rectified ſpirits of wine, they ſhall not
olve the wax ſo readily, nor incorporate with it in the ſame
ner. Not to mention other circumſtances at preſent.

Account of Experiments made on Ambergreaſe; *by Mr.* ohn Browne, *and M.* Godfrey Hanckewitz, Phil. Tranſ. N° 435. p. 437. Tranſlated from the Latin.

HE Royal Society ordered Mr. *Brown* and M. *Hancke-witz* carefully to repeat Dr. *Neuman*'s proceſs on amber-
ſe. Mr. *Browne* judging that the Dr. had in his experiment
de uſe of too ſmall a quantity of ambergreaſe, namely, a
le drachm, took an ounce and an half, together with very
white cimolian earth, (which he always makes uſe of for
acting the ſalt from amber) reduced to a powder, and put-
them into a retort he expoſed them to different degrees
heat; he firſt obtain'd a pellucid phlegm like the pureſt
er, then a deep ſpirit like beer, after that there came
an oil, of a deeper colour, and laſt of all, with a very
ng fire, he obtain'd a thick black balſam. The oil and
ſam he owns, had the ſame ſmell with thoſe got from am-
, but without any acid volatile ſalt, nor did the ſpirit from
bergreaſe ferment with alkali's, as that from amber does
ch abounds with ſuch an acid ſalt: He takes that volatile
acid

acid to be the peculiar criterion of amber. The remains o
amber after distillation, are hard, black, and like jet; but af
ter distilling the ambergrease, the earth only remained tinge
black; and therefore since he could not perceive any acidity o
volatility throughout the whole process, he leaves it undete
mined, whether ambergrease be an animal excrement or not
but he observes that all its grateful odour, is entirely lost
the gentlest fire.

M. *Hanckewitz* distill'd in a retort 2 ounces of ambergr
mixt with double the quantity of very pure white sand
and after that, he distilled in like manner other 2 ounce
and in each process he got a limpid oil, and the remainder w
bituminous: The oil rectified *per se* yielded a phlegm of
grateful subacid taste, like a weaker vinegar, and after th
there came over a limpid, balsamick, bituminous oil, like p
trol: He distill'd half an ounce of ambergrease *per se*, a
with a pretty moderate fire he obtain'd the same things. Af
distilling the ambergrease to the greatest degree of dryne
he urged the remainder with the strongest fire, and at l
there remained 3 grains of a white saline earth, that cause
moderate effervessence with acids, or runs *per deliquium* wh
exposed to a moist air, since he could obtain no volatile salt, n
phosphorus from the coal or blackish remainder of the 2 fi
processes, he concludes with the greatest assurance, that amb
grease is no animal substance, or excrement: For, phospho
may be got from the excrements of all known animals, as
has abundantly shewn in *Phil. Trans.* N° 428. He theref
takes ambergrease for a bitumen, nearly approaching to t
nature of amber; but not for a genuine amber; since it d
not yield an acid volatile salt, like that got from amber.

He again repeated the experiment with equal parts of a
bergrease and powder'd glass; because there might arise
suspicion of some alcaline earth adhering to the sand, t
might have absorbed whatever quantity of acid were got fr
the ambergrease; but the process exhibited again the sa
things, only that the phlegm had the taste of a neutral,
not an acid salt; and after the fire had fus'd the glass po
der, the bituminous remainder free from the mass of gl
lay upon it like a black coal, and spread itself over all the
side of the retort up to the very neck, like fine and shin
black flowers or flakes.

All controversy about these experiments may be easily
termined, if we consider ambergrease as a mixt consisting

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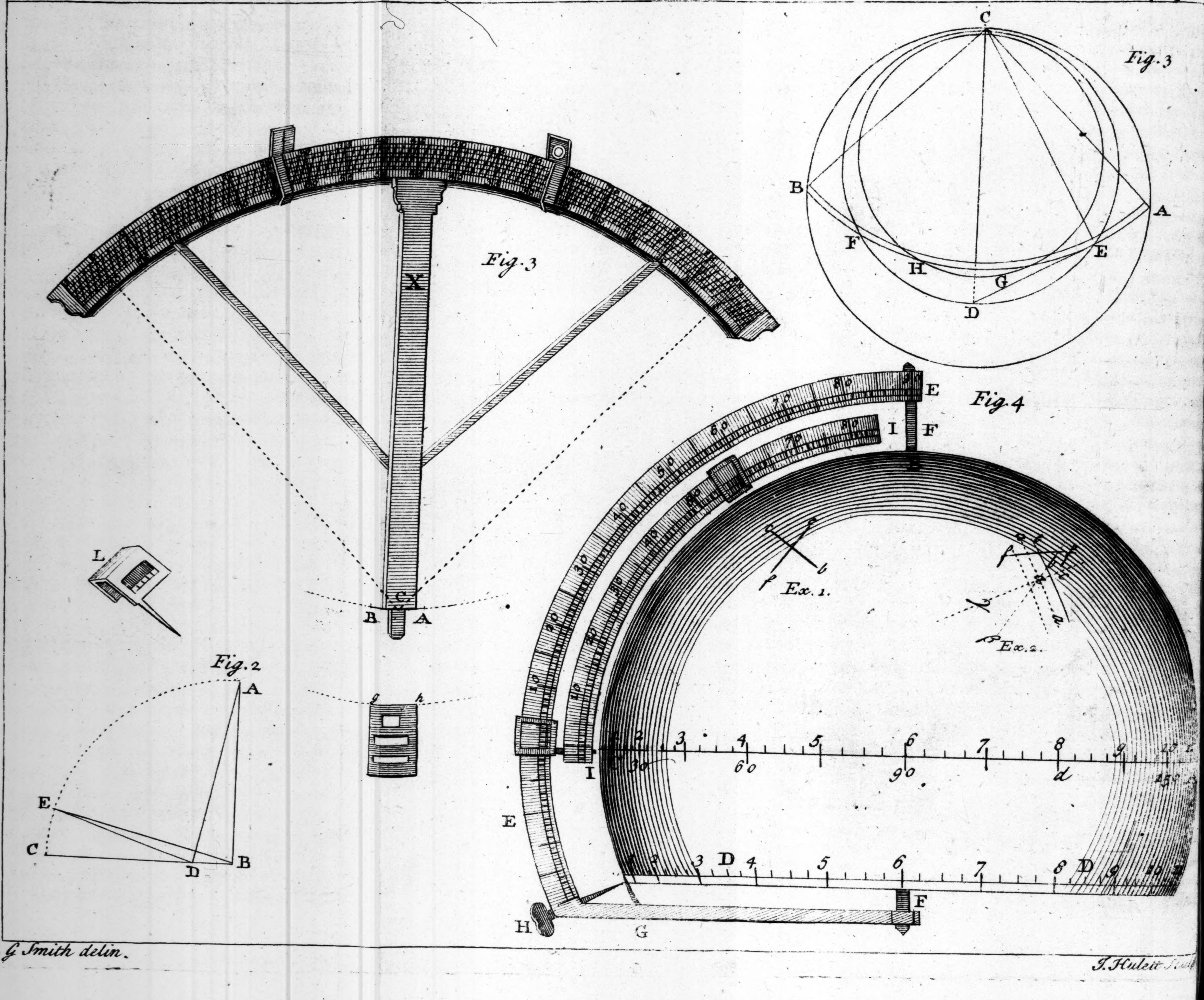

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J. Hulett Sculp.

veral adventitious matters, like other minerals, and not as a mple pure body like metals: For no ore of any metal, as lead, r instance, doth in all its parts exhibit an equal quantity of etal, or particular mixt mineral; in like manner the various arts of ambergrease do not contain the same quantity of that cid salt; as may be seen in M. *Godfrey*'s experiments, in ne of which the phlegm he got had a subacid taste, the unoubted sign of that salt; and in another it had the taste of a eutral salt; and that small portion of it, examined by Dr. *Neuman*, contained more of that salt than any other. Besides, he more that salt is entangled in the oil, the more difficultly is separated therefrom. In the same manner it happened in some xperiments on quick lime, according to Dr. *Neuman* in a etter to M. *Godfrey*, where he writes; that they succeeded ifferently in *England* and in *France*; whence it happened that certain *Frenchman*, upon repeating the same experiments, hat had succeeded in a certain manner in *England*, and finding hat they did not answer in the same manner in *France*, affirmed hat they were entirely false. Besides, Dr. *Neuman*, in another etter to Sir *Hans Sloane*, says, that he would not be understood s meaning p. 421. that ambergrease is really amber, but only genus thereof, or a bitumen nearly approaching to amber, which was the reason that the antients called both *ambar*, the ne *citrina*, and the other *odorifera*. Again he adds, as to he acid volatile salt, of which he obtained a grain or two, that e could not be deceived; for, it dissolved in water as comon salt does, and it tinged syrup of violets of a red colour, as ther acids do; and is volatile, because it ascends in Distillaion.

An Account of Mr. Thomas Godfrey's *Improvement of* Davis's *Quadrant, transferred to the Mariner's Bow, by Mr.* Logan. Phil. Transf. N° 435. p. 441.

THOMAS GODFREY of *Philadelphia*, having, under the greatest disadvantages, made himself master of he principles of astronomy and opticks, as well as other parts of mathematical science, applied his thoughts to consider the instruments made use of in that momentous part of business, navigation. He saw that on the knowledge of the latitude and longitude of the place a ship is in, the lives of thousands of useful subjects, as well as valuable cargoes, continually depend; that for finding the first of these, certain and easy methods are furnished by nature, if observation be duly made:

But *Davis*'s quadrant, the instrument generally made use of by *British* Navigators (tho' seldom by foreigners) he perceived was attended with this inconveniency, that the observer must bring the shade or spot of light from the sun, and the rays from the horizon, to coincide exactly on the fiducial edge of the horizontal vane; That tho' this can be done in moderate weather, and seas, with a clear sky, and when the sun is not too high, without any great difficulty; yet in other cases it requires more accuracy than can in some junctures possibly be applied, and more time than can be allowed for it. In *European* latitudes, or to those nearer the northern tropick, when the sun is in the southern signs, and near the meridian, he rises and falls but slowly: Yet in voyages to the *East* and *West-Indies*, of which a great many, especially to the latter, are made, he is at noon, often and for many days together, in or near the zenith; and when approaching to or leaving it, he rises and falls, when he has declination, faster than even at the horizon: For, it is well known to persons acquainted with the sphere, that when his diurnal course takes the zenith, he there rises and falls a whole degree or 60 minutes in the space of 4 minutes of time: So that the observer has but one minute, to come within 15 minutes of the truth in his latitude: While in a middle altitude, as 45 degrees he is at noon above 5 minutes and ½ in time, in rising or falling one single minute of space, the odds between which is more than 80 to 1. And yet, perhaps, no parts of the world require more exactness in taking the latitude than is necessary in voyages to the *West-Indies*: For, it is owing to the difficulty of it, that vessels have so frequently missed the island of *Barbadoes*, and when got to the leeward of it have been obliged to run down a thousand miles farther to *Jamaica*; from whence they can scarce work up again in the space of several weeks, against the constant trade winds; and therefore, generally decline to try for, or attempt it.

But farther, as the latitude cannot be found by any other method that our mariners are generally acquainted with, than by the sun or a star on the meridian: In a cloudy sky, when the sun can but now and then be seen, and that only between the openings of the clouds for very short intervals, which those who use the sea know frequently happens: As also in high tempestuous seas, when tho' the sun should appear, the observer can scarce by any means hold his feet; it would certainly be of vast advantage to have an instrument, by which an observation could also be snatch'd, as it were, or taken in much less

time

ime than is generally required in the use of the common quadrant.

Thomas Godfrey, therefore, considering this, applied himself o find out some contrivance, by which the necessity of bringing the rays from the sun and those from the horizon to coincide (which is the most difficult part of the work) on one particular point or line from the center, might be remov'd. In order to which he consider'd, that by the 21. 3. *Eucl. Elem.* ll angles at the periphery of a circle, subtended by the same segment within it are equal on whatever part of the circumference he angular point falls; and therefore, if instead of a quadrant, a semicircle were graduated into 90 degrees only, accounting every two degrees but one; this would effectually answer: For then, if an arch of the same circle were placed at the end of the diameter of the instrument, every part of that opposite arch would equally serve for taking the coincidence of the rays abovementioned: But such an instrument would manifestly be attended with great inconveniencies; for, it would in great altitudes be much more unmanageable, and the vanes could not be framed to stand, as they always ought, perpendicular to the rays: He, therefore, farther resolv'd to try whether a curve could not be found to be placed at the centre of the quadrant, which would, at least for a length sufficient to catch the coincidence of the rays, with ease fully answer the intention.

A curve, that in all its parts would, in geometrical strictness, effect this, cannot be in nature, any more than that one and the same point can be found for a centre to different circles, which are not concentric: It is certain that every arch on the limb may have a circle that will pass through the centre, and be a locus or geometrical place for the angle made by that arch to fall on; but then every arch has a different one from all others, as in fig. 1. Plate III. Let A B C be the quadrant, and A B, E F, G H be taken as arches of it; circles, drawn through each two of these respectively, and through the centre C as a third point, will manifestly be such loci or places: For, every pair of these points stand in a segment of their own circle, as well as on a segment of the quadrant, and therefore by the cited 21. 3d *Elem.* the angles standing on these first segments will every where be equal at the periphery of their respective circles, and their radius will always be equal to half the secant of half the arch on the quadrant: For, in the circle C E D F, for instance, the angle C E D is right, because in a semicircle, C E is the radius of the quadrant, E D the tangent

 of

of the angle D C E $= \frac{1}{2}$ the arch E F, and C D is the ſecan
of the ſame, equal to the diameter of the circle C E D F, an
therefore its radius is half that ſecant.

Now from the figure it is plain, that in very ſmall arche the radius of their circular place will be half the radius of th quadrant, *i. e.* putting this radius $= 10$, the other will be 5 And the radius for the arch of 90, the higheſt to be uſed o the quadrant, will be the ſquare root of half the ſquare of th radius $=$ ſine of $45^\circ = 7.071$, and the arches at the centr drawn by theſe two radii, are the extremes, the medium o which is 6.0355: And if a circular arch be drawn with thi radius $\frac{1}{20}$ part of the length of it, *i. e.* in an inſtrument of 2 inches radius, the length of one inch on each ſide of the cen tre affording two inches in the whole, to catch the coinciden of the rays on, which muſt be own'd is abundantly ſufficien the error at the greateſt variation of the arches, and at the e tremity of theſe two inches, will not much exceed one mi nute.

But in fixing the curvature or radius of this central arc ſomething farther than a medium between the extreams in th radius is to be conſider'd: For, in ſmall arches the variatio is very ſmall, but in greater, it equally increaſes, as in fig. where it appears, the difference between the angles A B C a A D C is much greater than the difference between E B C a E D C, tho' both are ſubtended by the ſame line B D: F their differences are the angles B A D, and B E D. Ther fore, this inequality was likewiſe to be conſider'd; and com pounding both together, *Thomas Godfrey* pitch'd on the rat of 7 to 11 for the radius of the curve to the radius of th inſtrument, which is 6.3636 to 10. But upon farther conſid ration he now concludes on $6\frac{4}{10}$; and a curve of this radi of an inch on each ſide of the centre to an inſtrument of inches radius, or of $\frac{1}{20}$ of the radius whatever it be, will in caſe whatever, as he has himſelf carefully computed it, produ an error of above 57 ſeconds; and it is very well know that navigators do (as they very ſafely may) in their voyag entirely ſlight a difference of one minute in latitude.

This radius is the true one for the circular place to an ar of $77^\circ\ 15'$, and the variation from it is nearly as great at degrees as at any arch below it; the greateſt below being about 44 degrees, which is owing to the differences expreſs'd fig. 2. and not to thoſe of the curvatures or circular places. Y this variation of 57 ſeconds ariſes only, when the ſpot or co ciden

dence falls at the extremity of the horizontal ſight or vane, a whole inch (in an inſtrument of 20 inches radius) from the ntre, and then only in the altitudes or arches of about 44 or o degrees. And in theſe, at the diſtance of $\frac{1}{2}$ an inch from e centre, the variation is but $\frac{1}{4}$ ſo much, *viz.* about 14″; and $\frac{1}{4}$ of an inch not 4″; at the centre it is preciſely true. As, herefore, an obſervation may be taken with it in $\frac{1}{4}$ of the time, hat *Davis's* quadrant (in which 3 things muſt be brought to eet) in a general way requires: Conſidering this and the vaſt nportance of ſuch diſpatch, in the caſe of great altitudes, or f tempeſtuous ſeas, or beclouded ſkies, it is preſumed the inrument thus made will be judged preferable to all others of the ind, hitherto known. Some maſters of veſſels, who ſail from *Philadelphia* to the *Weſt Indies*, have got of them made as ell as they can be done there; and have found ſo great an adantage in the facility and in the ready uſe of them, in thoſe utherly latitudes, that they reject all others. And it can carce be doubted, but when the inſtrument becomes more genelly known, it may more univerſally obtain in practice.

In 1730, after *Thomas Godfrey* was ſatisfied in this improvenent, he applied himſelf to think of the other, *viz.* the reecting inſtrument by ſpeculums, for a help in the caſe of lonitude, tho' it is alſo uſeful in taking altitudes; and one of heſe, as has been abundantly proved by the maker, and thoſe ho had it with them, was taken to ſea, and there us'd in oberving the latitude the winter of that year. In *May*, 1732 Ir. *Logan* tranſmitted an account of it to Dr. *Halley*. This, n his part, is all the merit he has to claim in either of theſe nſtruments.

Mr. *Logan* only adds, that the bow had beſt be an arch of bout 100 degrees, well graduated, and number'd both ways; he radius to be of 20 or 24 inches; the curve at the centre to e $\frac{1}{20}$ of the radius on each ſide, that is $\frac{1}{10}$ of it in the whole; he radius of that curve $1\frac{64}{100}$ parts of the radius of the inſtrunent; that the glaſs for the ſolar vane ſhould not be leſs, but ather larger, than a ſilver ſhilling, with its vertex very exactly et: And that the utmoſt care be taken to place the middle of he curve at the centre exactly perpendicular to the line or adius of 45 degrees. As the obſerver muſt likewiſe take care, hat the 2 vanes on the limb be kept nearly equi-diſtant from hat degree; to which he only adds, that it may be beſt to ive the horizontal vane only one aperture, and not two. The eſt he ſuppoſes may be left to the workmen.

Note,

Note, that the radius of the quadrant being divided into 2[…] equal parts, the centre × (Fig. 3.) of the curvature of the hori[…] zontal vane, A B, must be 12 $\frac{8}{10}$ of those parts from the centr[…] C of the quadrant. The breadth A B or *g b* of that va[…] should be $\frac{1}{10}$ of the whole radius, that is $\frac{1}{20}$ on each side o[…] the centre C.

The Description and Use of an Instrument for taking the La[…] titude of a Place at any time of the Day; by Mr. Richar[…] Graham. Phil. Transf. N° 435. p. 450.

THE necessity of finding the latitude a ship is in, is to[…] well known to be insisted on; frequent opportunities o[…] observing the latitude must, consequently, be of very great ad[…] vantage to navigation. The method usually practis'd is b[…] taking the sun or stars meridian altitude or zenith distance; I[…] this case, if the sun do not shine but for some small time only[…] before and after noon, tho' it be clear all the rest of the day[…] it is of no use for this purpose: In 1728 Mr. *Fatio* propos'd [...] method for finding the latitude, from 2 or more observations o[…] the sun, or stars, at any time, the distance of the said observa[…] tions in time being given by a watch: But as his method re[…] quires a vast number of computations, and a great deal o[…] skill in spherical trigonometry, it has very seldom been mad[…] use of, and never but by good Mathematicians. The instru[…] ment here described will answer the same end, and has the fol[…] lowing advantages; *viz.* 1. It may be very easily understood b[…] seamen. 2. It immediately shews the latitude of the place[…] 3. It gives the time of day at sea, when no other instrument[…] can. 4. It may be made as large; and consequently as accurate[…] as is desir'd.

The description of the instrument is as follows; A B C[…] (Fig. 4. Plate III.) represents part of the hemisphere of a large[…] globe (half the globe, and the part below the tropic, are cut[…] off, that it may take up the less room) A C half the equator[…] divided into 12 hours above, and 180 degrees below, and sub[…] divided into minutes, as is likewise the lower tropic D D; E E[…] a moveable graduated meridian, turning on the axis F F; G[…] an index to fix it (by means of the screw H) to any hour; I *i*[…] a circular beam-compass, the centre I *i* to be fixt on the meri[…] dian to any degree and minute of declination, by the method[…] commonly call'd *Nonius*'s divisions; *k* the point for drawing[…] arches, which is likewise fixt to any degree and minute by the[…] same method. As the meridian is at some distance from the[…] globe[…]

be, L is a piece of braſs to fix on the meridian, marked
Nonius's diviſions, with a point reaching down to
interſection of the arches, by which means the diſtance
he ſaid interſection from the equator, or its latitude,
ound. The degrees and minutes may likewiſe be ſhewn by
gonal lines.

The uſe of the inſtrument is, as follows.

Propoſition 1. From 2 obſervations of the height of the ſun, diſtance of the ſaid obſervations in time, being given by a ch, as alſo the declination of the ſun; to find the latitude of place and hour of the day.

. When the ſhip is at reſt, that is, at anchor, or in a calm; s to have little or no progreſſive motion.

Caſe 1. Suppoſe the ſun in the equator, on the day of obation: Fix the center of the beam-compaſs at 0 degree, t the equator; and move the point *k* to the zenith diſe (the complement of the altitude taken by the uſual ruments) and from any hour as from C, deſcribe an arch of rcle with the ſaid point, as *bc* (*Ex.*1. Fig.4.) Suppoſe 8 hours r by your watch, you have another obſervation; move the idian 8 hours farther to *d* and fix it there; and with the ith diſtance then obſerved, deſcribe another arch as *ef*; point where it cuts the former is the place of obſervation; its diſtance taken on the meridian from the equator ws its latitude; and the minutes reckon'd on the equator n the meridian to C and *d* (the times of obſervation) ſhew t thoſe hours were.

Caſe 2. When the ſun has declination. Fix the centre of beam-compaſs on the meridian, to the proper degree of lination for the day of obſervation, and proceed as before.

Caſe 3. If the obſervations are at a greater diſtance than hours, but in the ſame day. Make uſe of the complent to 24 hours of the diſtance in time, and take the deation on the contrary, or lower ſide of the equator; and ead of the zenith diſtances, take the nadir diſtances, or udes, increaſed by 90 degrees.

Thus, you will find the latitude and time of each obſeron from midnight. In this caſe the beam-compaſs muſt end to more than 90 degrees.

Caſe 4. If the obſervations are more than a day aſunder; or inſtance a day and two hours, namely 26 hours. Place centre of the beam-compaſs two hours farther than it was day before; but in different declinations, according to table of declination for the ſeveral days.

Caſe

Caſe 5. When the obſervations are made by a ſtar. T
centre of the beam-compaſs muſt be ſet to the declinatio
the ſtar; then proceed as before. To find the hour in t
caſe, the right aſcenſion muſt likewiſe be given.

Scholium. The ſame method may be uſeful at land, w
no meridian obſervation offers.

2. When the ſhip is in motion.

Caſe 1. Suppoſe the ſun in the equator; the diſtance b
tween the 2 obſervations 8 hours, as before; and the arch *a*
(*Ex.* 2. Fi. 4.) deſcribed by the zenith diſtance of the firſt
ſervation, from the centre C; and the angle *c a b*, 40 degr
is the angle between the ſhip's way, and the azimuth of
ſun continued (given by the azimuth compaſs) and that d
ing the 8 hours, the ſhip has made one degree or 60 minu
from *a* to *b*, or from the ſun; then as the radius is to the
ſine of *c a b*, 40 degrees; ſo is *ab*, 60 minutes, to *ac*,
minutes: Add 46 minutes to the zenith diſtance C *a*;
with *k*, the point of the beam-compaſſes ſet at that diſta
deſcribe the arch *c b e*; then with the zenith diſtance of
laſt obſervation, whoſe centre is *d*, draw the arch *ff*;
point where it cuts the arch *c b e* is the place where the ſ
was laſt; and its diſtance taken on the meridian from
equator ſhews its latitude; the minutes reckon'd on
equator from the meridian to *d* (the time of the laſt ob
vation) ſhew the hour, or its diſtance from 12 o'clock.

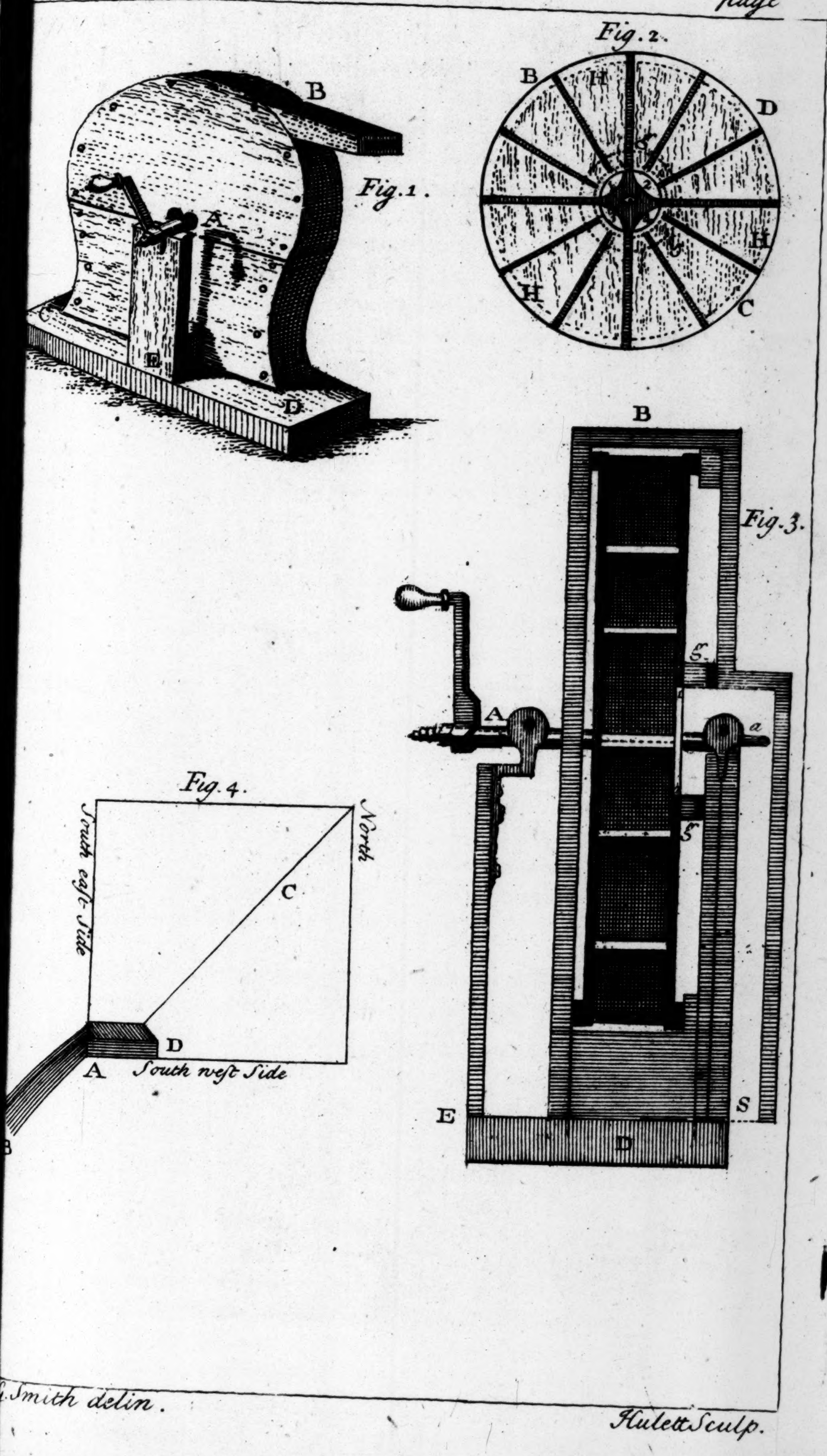
Caſe 2. If the ſhip had ſailed from *a* to *β*, or towards
ſun: The coſine of the angle *β a γ*, or of the angle betw
the ſhip's way and the ſun, muſt be ſubſtracted from the
nith diſtance of the firſt obſervation.

N. B. Only the 2 arches *c be*, *ff*, are to be drawn on
globe, the reſt being added here, to ſhew the reaſon of
conſtruction.

Caſe 3. To find the latitude of the firſt place. From
equator, with a pair of compaſſes, take the diſtance ſail'd
minutes; and with one foot in the interſection of the arc
be, *ff*, the place found before, put the other in the a
a a a, the zenith diſtance of the firſt obſervation; and
this inſtance, on the left hand of the azimuth of the ſun,
is the place ſought; and its diſtance taken on the meridi
from the equator, ſhews the latitude; and the minu
reckon'd on the equator from the meridian to C, the time
the firſt obſervation, ſhew the hour.

The interval in time, or the degree between the 2 pla
ſhewn by the index G, is the difference of longitude.

N.



Smith delin. Hulett Sculp.

N. B. Thoſe obſervations are beſt, whoſe arches croſs each ther almoſt at right angles.

Prop. 2. The zenith diſtance of 2 ſtars, obſerved at the me time, their declination and right aſcenſion being known; find the latitude of the place of obſervation.

Fix the centre of the beam-compaſs to the declination of ther of the ſtars, and with the zenith diſtance of that ſtar eſcribe an arch: Move the meridian as many hours farther, s is the difference of right aſcenſion of the other ſtar; and x the centre of the beam-compaſs to the declination of it; nd with its zenith diſtance croſs the firſt arch: The inter-ction ſhews the latitude of the place of obſervation; and kewiſe the diſtance of the right aſcenſion of the zenith from at of either of the ſtars; by which means the hour may be nown.

If a celeſtial globe be made uſe of, then place the centre f the beam-compaſs over the ſeveral ſtars.

The latitude and hour being given, the variation of the ompaſs is eaſily known.

N. B. In order to draw arches on the globe, rub ſome owder'd black lead on a piece of paper; lay the ſide which s blacked next the globe, where you imagine the interſection f the arches will be: Then draw them on the clean ſide ith the point of the beam-compaſs; and they will appear n the globe; and if the globe be well varniſh'd, they may e rubbed out with bread, or waſh'd out with water.

As altitudes at ſea are now readily taken with great ex-ctneſs, by the quadrant, invented by Mr. *Hadley*; and as he ſaid altitudes are the principles, on which the operations bove deſcribed are founded; the previous uſe of that qua-rant cannot but be of the utmoſt importance to thoſe who hall have occaſion for this inſtrument.

An Abſtract of Meteorological Diaries, *with Remarks there-on; by Dr.* Derham. Phil. Tranſ. N° 435. p. 458.

THE following meteorological obſervations were made at *Hall* in *Saxony*, by M. *Joach. Langen*, *Ann.* 1729; nd in 1728 at *Goſlar* in *Lower Saxony*, by Dr. *Joh. Conrad rumphins*; at *Wittemberg* in *Saxony*, by Dr. *Weidler*; at *aples* by Dr. *Cyrillus*; at *Southwick* in *Northamptonſhire*, y Mr. *Lynn*; and in *Sweden*, at *Lunden*, *Bettna*, *Upſal* and *ygdea*, to which the illuſtrious obſervers have added obſer-ations from *Swenæker*, in *Weſtro-Gothia* (Lat. 58° 10′) by M. *Vaſ-*

M. *Vassenius*, minister in *Wassenda*; at *Wisingsœ*, by *Magnus Oxelgren*, Lecturer of the College; at *Risinge* in *Ostro-Goth*, by *Sueno Laurelius*, Pastor and Provost there. At *Stockholm* (Lat. 59° 30′) by *Joh. Backman*, Citizen; at *Hudickswald Helsingorum*, by *Olave Broman*, Pastor there; at *Hernœsand* and *Angermann*, by *Jac. Renmarck*, Lecturer of the Mathematics; at *Lœsanger* and *Umea* (Lat. 63° 43′) by *Bern. Ask*, student of Divinity; and at *Torneao* in *Westro-Goth* (Lat. 65° 43′) by *Abr. Fougt*, Pastor there.

A Table of the highest, mean, and lowest, barometrical stations, in 1728.

	JANUARY.			FEBRUARY.		
	High	Mean	Low	High	Mean	Low
Hall	$29.4\frac{1}{2}$	$28.7\frac{1}{2}$	$28.1\frac{1}{3}$	29. 7	28.10	28. 2
Goslar						
Wittemberg	$30.2\frac{1}{2}$	$29.5\frac{3}{4}$	28. 9	$30.2\frac{7}{8}$	29. 9	29. 3
Naples	29.88	29.50	29.12	29.88	29.71	29.54
Southwick	30.08	29.37	28.67	30.10	29.84	29.58
Lunden	30.20	29.46	28.72	30.22	29.52	28.82
Swenæker	30.36	29.68	29. 0	30.35	29.32	28.29
Risinge	30.20	29.55	28.90	30.20	29.52	28.85
Bettna	30.80	30.10	29.40	30.80	30.12	29.45
Upsale	30.46	29.85	29.24	30.50	29.86	29.23
Hudickswald	30.50	29.75	29.01	30.56	29.89	29.22
Hernœsand	30.60	29.95	29.30	30.50	29.79	29.08
Bygdea.	30.30	29.75	29.20	30.40	29.67	28.94

MARCH.

	High	Mean	Low		High	Mean	Low
Hall	29. 2	$28.9\frac{1}{2}$	28. 5	Risinge	29.67	29. 0	28.2[illegible]
Goslar	31. 3	30.10	30. 6	Bettna	30.21	29.55	28.9[illegible]
Wittemberg	$29.9\frac{7}{8}$	29. 5	$29.1\frac{1}{3}$	Upsale	30.00	29.40	28.8[illegible]
Naples	29.88	29.63	29.28	Hudickswald	30.24	29.52	28.8[illegible]
Southwick	29.88	29.35	28.[illegible]	Hernœsand	30.25	29.47	28.7[illegible]
Lunden	29.81	29.16	28.51	Bygdea.	30.28	25.39	28.5[illegible]
Swenæker	29.73	29.05	28.37				

APRIL

	April.			May.		
	High	Mean	Low	High	Mean	Low
Hall	28.11	28. 8	28. 5	29.1⅓	28. 8	28.3½
Goslar	31. 4	30.11	30. 6	31. 5	31.0½	30. 8
Wittemberg	30. 0	29.4½	28. 9	30. 1	29. 8	29 2½
Naples	29.88	29.75	29.63	29.80	29.71	29 63
Southwick	29.94	29.48	29.03	29.96	29.51	29.07
Lunden	29.73	29.22	28.51	30.02	29.57	29.12
Swenæker	29.83	29.05	28.27	30.07	29.26	28.45
Risinge	29.70	29.06	28.43	29.95	29.35	28.75
Bettna	30.22	29.63	29.05	30.50	29 90	29.30
Upsale	30.00	29.49	28.98	30.29	29 73	29 17
Hudicksward	30.10	29.60	29.10	30.38	29.79	29.20
Hernœsand	30. 7	29.50	29.07	30.20	29.72	29.24
Bygdea.	29.80	29.40	29.00	30.10	29.62	29.14

	June.			July.		
	High	Mean	Low	High	Mean	Low
Hall	29.0¾	28. 8	28. 3	28.11	28. 8	28. 5
Goslar	31. 4	31.0½	30. 9	31. 3	30.11	30. 7
Wittemberg	30. 0	29.8½	29. 5	30. ¾	29. 7	29.3½
Naples	29.88	29.75	29.93	29.80	29.71	29.63
Southwick	29.93	29.70	29.27	29.95	29.57	29.20
Lunden	29.83	29.52	29.21	29.73	29 38	29.02
Swenæker	29.93	29.49	29.06	30.10	29.19	28.28
Risinge	29.70	29.35	29.00	29.50	29.15	28.80
Bettna	30.20	29.89	29.58	30.12	29.66	29.20
Upsale	30. 9	29.73	29.38	29.91	29.55	29.20
Hudicksward	30.96	30.09	29.22	30 05	29.61	29.18
Hernœsand	30.10	29.71	29.32	29.97	29.53	29.10
Bygdea.	29.96	29.42	28.88	29.85	29.42	29.00

	August.		
	High	Mean	Low
Hall	29. 0	28.8½	28. 5
Goslar	31. 5	31. 0	30.9½
Wittemberg	30. ½	29. 8	29.4½
Naples	29.88	29.80	29.72
Southwick	30.04	29.51	28.98
Lunden	29.92	29.37	28.82
Swenæker	29.74	29.19	28.64

Au

August.

	High	Mean	Low
Riſinge	29.57	28.86	28.15
Bettna	30.10	29.56	29.02
Upſale	29.91	29.45	29.00
Hudickſwald	29.90	29.48	29.07
Hernœſand			
Bygdea	29.96	29.58	29.20
Torneao	29.85	29.56	29.27

	September.			October.		
	High	Mean	Low	High	Mean	Low
Hall	29. 1	28.10	28. 8			
Goſlar	31. 5	31.0$\frac{1}{2}$	30. 8	31. 5	31. 0	30. 6
Wittemberg	30. 0	29.7$\frac{1}{2}$	29. 3	30. $\frac{1}{2}$	29. 6	29. 2
Naples	29.88	29.54	29.21	29.80	29.71	29.52
Southwick	30.02	29.53	29.04	29.98	29.31	28.64
Lunden	29.91	29.45	29.00	30.12	29.51	28.90
Swenæker	29.93	29.39	28.86	30.26	29.55	28.84
Riſinge	29.95	29.32	28.70	30.16	29.43	28.70
Bettna	30.38	20.83	29.28	30.80	30.02	29.25
Upſale	30.17	29.71	29.25	30.49	29.83	29.16
Hudickſwald	30.21	29.74	29.27	30.97	29.99	29.01
Hernœſand						
Bygdea	30. 2	29.53	29.05	30.40	29.70	29. 0
Torneao	29.92	29.56	29.20	29.90	29.58	29.25

	November.			December.		
	High	Mean	Low	High	Mean	Low
Goſlar	31. 6	30. 5	30. 6	31. 8	31. 1	30. 4
Wittemberg	30. $\frac{1}{3}$	29. 0	28. 9	30. 2	29. 6	29. 1
Naples	29.96	29.67	29.38	29.80	29.51	29.21
Southwick	29.95	29.45	28.91	30.04	29.42	28.80
Lunden	29.90	29.26	28.62	29.92	29.32	28.73
Swenæker	29.95	29.14	28.34	30.16	29.53	28.91
Riſinge	29.80	29.05	28.30	30.05	29.42	28.80
Bettna	30.40	29.70	29.01	30.70	30.11	29.52
Upſale	30.10	29.44	28.79	30.49	29.87	29.25
Hudickſwald	30.22	29.47	29.72	30.60	29.95	29.30
Bygdea	30.24	29.42	28.60	30.50	29.80	29.10

A thermometrical table of the highest, lowest and mean stations at *Naples*, *Southwick*, *Lunden* and *Upsal*, in 1728.

	January.			February.			March.		
	High	Mean	Low	High	Mean	Low	High	Mean	Low
Naples	49.05	43. 5	38. 5	48. 0	44. 5	35. 0	39. 5	35. 9	32. 3
Southwick	79	67	55	80	67	54	69	57	45
Lunden	83	68	54	91	73	56	123	98	74
Upsale.	91. 5	80. 9	68. 3	89. 2	77. 9	66. 6	72. 1	63. 0	53. 9

	April.			May.			June.		
	High	Mean	Low	High	Mean	Low	High	Mean	Low
Naples	42. 5	33. 2	24. 0	26. 0	18. 5	11. 0	16. 0	9. 7	4. 5
Southwick	71. 0	53	36	56	40	24	50	35	19
Lunden	148	118	85	172	145	118	176	153	130
Upsale	69. 5	52. 1	44. 7	54. 7	45. 0	35. 3	42. 0	33. 6	25. 2

	July.			August.			September.		
	High	Mean	Low	High	Mean	Low	High	Mean	Low
Naples	13. 5	8. 2	3. 0	16. 0	10. 0	4. 0	26. 5	17. 1	7. 7
Southwick	50	34	17	56	39	23	65	48	32
Lunden	172	152	132	153	133	113	150	122	94
Upsale	37. 2	31. 0	25. 5	40. 2	32. 8	25. 5	58. 4	46. 2	34. 6

	October.			November.			December.		
	High	Mean	Low	High	Mean	Low	High	Mean	Low
Naples	40. 0	31. 3	22. 5	48. 0	42. 0	34. 0	54. 5	54. 5	44. 7
Southwick	71	56	41	84	64	43	87	72	58
Lunden	119	98	78	109	87	64	83	71	59
Upsale	68. 2	58	47. 7	98. 0	57. 0	56. 1	89. 6	76. 8	64. 0

A Table

A Table of the Rain *at* Southwick *and* Naples *in the Year* 1728.

	Southwick		Naples.			Southwick		Naples.	
	Inch	Cent.	Inch	Measures		Inch	Cent.	Inch	Measur
Jan.	4.	00	4.	15½	Jul.	3.	21	0.	00
Feb.	0.	99	0.	00	Aug.	0.	96	.	00
Mar.	3.	27	0.	5	Sept.	0.	86	4.	4
Apr.	1.	97	0.	14	Oct.	2.	79	6.	17½
May	1.	44	0.	00	Nov.	1.	52	2.	7
June	2.	82	1.	2½	Dec.	2.	43	6.	8½

Rain in the whole Year.

At Southwick, *is* 26 *Inches, and* 26 *Centesimals.*

At Naples, *is* 19 *Inches, and* 14 *Measures.*

To make the meteorological observations of 1728 as usef as possible, Dr. *Derham* has put as many of them as he cou into tables, to be seen and compar'd at an easy view; but h was obliged to omit such of them, where no account is giv of the instruments they us'd, or where none at all were mad use of, but only verbal descriptions given, which tables wou not admit of. But the places mentioned in the tables had M *Hauksbee*'s glasses.

As to the barometrical observations the Dr. only repeats tw things he formerly took notice of, and has had frequent confi mation of *An.* 1728; 1. The great conformity of the ascent descents, and stations of the mercury in the barometer. 2. Th the range of the mercury is much greater in the northerly tha southerly climates.

As to the thermometrical observations, he has inserted a that were made with the *Royal Society*'s glasses; but such as we made with other thermometers would have been of little or n use, unless they could have been reduced to some known mea sure, which only two of the curious observers enabled him t do: But he found that matter so perplex'd and difficult, a not to answer the great trouble of it, especially considering tha the tables exhibit observations, made in different and distin parts, *viz. Italy*, *Germany*, *England*, and *Sweden*; by whic an estimate, may, in some measure, be made of the temperatu of those different climates of the world. In order to which th

Dr

takes notice, that the point of extreme heat in the *Royal So-*
y's glasses is 5 degrees above 0, and of freezing at 65 degrees;
if we cast our eye upon the several months, particularly
se of winter; especially if we consider what the Dr. remark'd
727 from Dr. *Cyrillus*, concerning the freezing point, which
Naples is at 55 degrees, at *London* 65 degrees, and at *Chri-*
na and *Bengal*, probably as different. Considering these
ngs it is surprising, that the heat and cold of those distant
ces is not as different as the northerly and southerly situati-
. But at *Lunden* he was surprised to find the thermometer
ch lower in the warmer months than at *Upsal*, or any other
the *Swedish* places, till he found that in all those months,
y had continual cold and rain, when the other places men-
little but fair, or cloudy, and but little rain or cold. And
reminds him of a former observation, *viz.* that cold is the
ent of wet, especially in summer.

As to the winds and weather, so many are the places of
ervation, and so various the observations, that it is almost
possible to give a tolerable abridgment of them, and the
ctor's remarks therefore on the foregoing years, especially on
same places and parts of the world, (*vide Phil. Trans.*
433. *p.* 334, *& seq.*) must suffice here.

The quantity of rain and snow was observ'd at *Naples*, *Ri-*
ge, *Bettna*, *Upsal*, *Hudickswald*, and *Southwick*; but he
ds no description of the instruments with which the obser-
ions were made, nor of the measures, except at *Southwick*
Naples, where the depth is measured by *English* measure;
Southwick by inches, and hundreth parts of an inch; and
Naples, by *English* inches, and the observer's measures, 23
which make an *English* inch.

Here follows an account of such meteors as the illustrious
ervers have taken notice of, together with some of the Dr's
n that happened about the same time.

In the night after *March* 20. a *lumen boreale* was observ'd
Bettna; and at half an hour after 8 on *March* 22. the Dr.
erv'd at *Windsor* an unusual sort of streaming, in which the
umns were not (as usual) conical or pointed, nor rising to-
rds the *Zenith* point; but were of parallel sides, and rose
pendicularly to the horizon. They were very bright, emit-
g a light equal to that of the moon in her quarters: They
o rose from a bank of vapours, not curv'd at top (as usual)
lacinated or broken.

Like-

Likewise on *March* 24, the curious *Bettna* observer said there was observed the night before, a *lumen efflammans boreale* which was also seen at *Læfanger*.

On *August* 26. at night, there was a remarkable *lumen boreale*, at *Bettna*: And the night before at 10 hours 20 minutes *p. m.* a gentleman, going from the Doctor's house, saw towards the east, about 30 degrees high, a ball of fire about inches diameter, blazing and standing still at first; and presently after running towards the north; and in about 5 minutes or more he heard an explosion like thunder; its blaze emitted a light equal to that of the moon at full.

At the same time the new-papers say, 'a light in the sky 'like a comet, was seen at *Wattford* in *Hertfordshire*, with 'sparks of fire issuing from its tail; that then it broke out 'with a prodigious lustre, like the sun, which lasted not long 'and was followed with a terrible clap of thunder, the stars 'twinkling all the while, and not a cloud to be seen.' Which clap, the Dr. doubts not, was the same his friend heard, and which was 5 or more minutes in its passage to *Upminster*.

At *Bettna*, *lumina borealia* were seen on the nights after *Sept*. 18, 19, and 24; the 2d of which cover'd half the heavens. And on *Sept*. 21. about 10 hours *p. m.* the Dr. observed at *Upminster* an unusual sort of tan-coloured thick vapours towards the N. W. *b*. N. but withal lightsome, and such as the stars might be seen through. And after some time they sent forth in divers places streaming lances, which gently and gradually came and went.

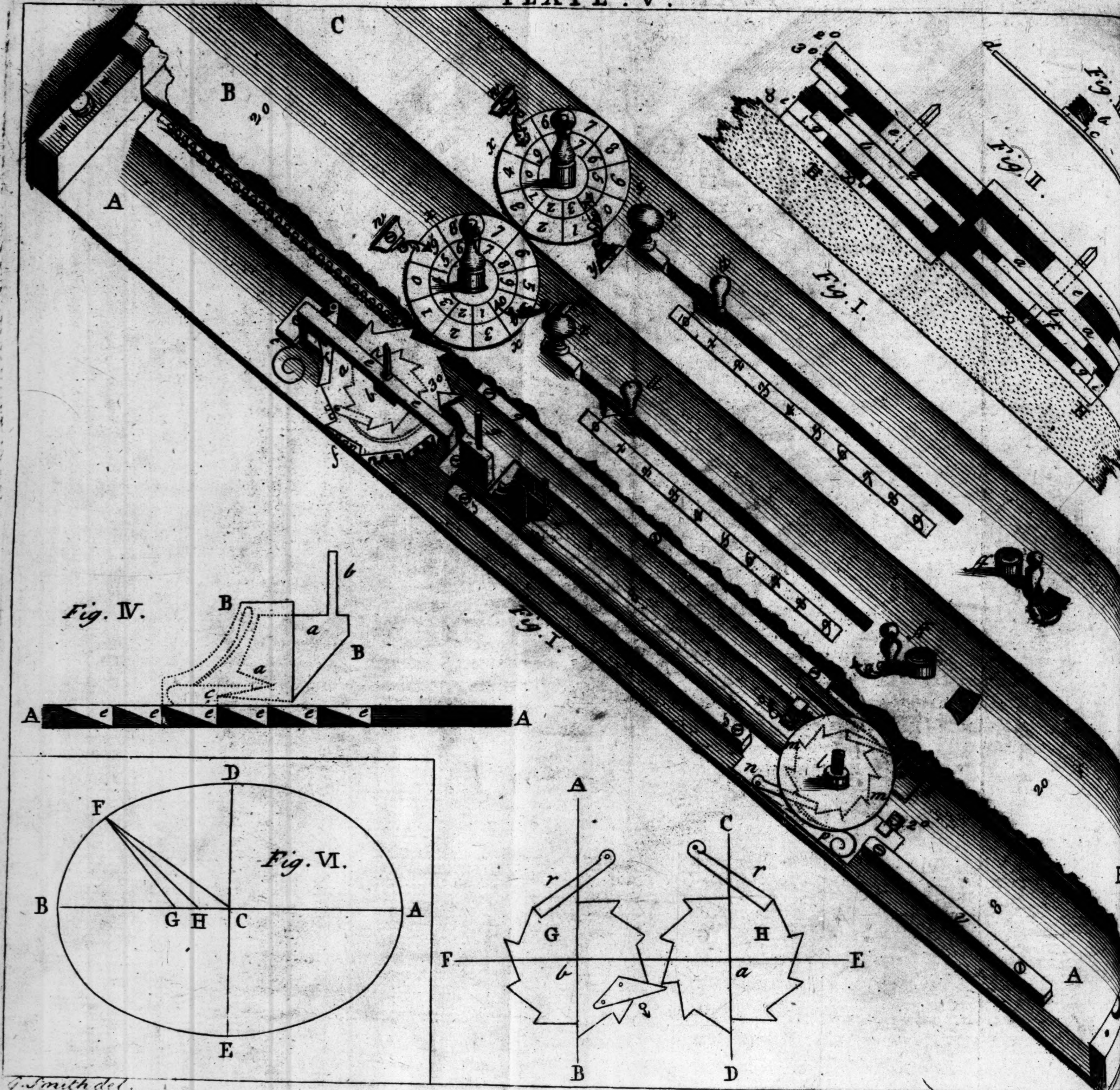
On *October* 13. the Dr. saw that uncommon sort of streaming at *Redbridge*, near *Southampton*, the account of which is published in *Phil. Trans*. N° 410. and the same night at *Bettna* there was a *lumen boreale eructans flammam*, as the observer expresses it: At *Læfanger* also those streamings were on the same night, and on the 15, 18, 19, and 23d.

On *October* 19. there was a parhelion at *Lunden*, and on the 22d a *lumen boreale* at *Wittemberg*.

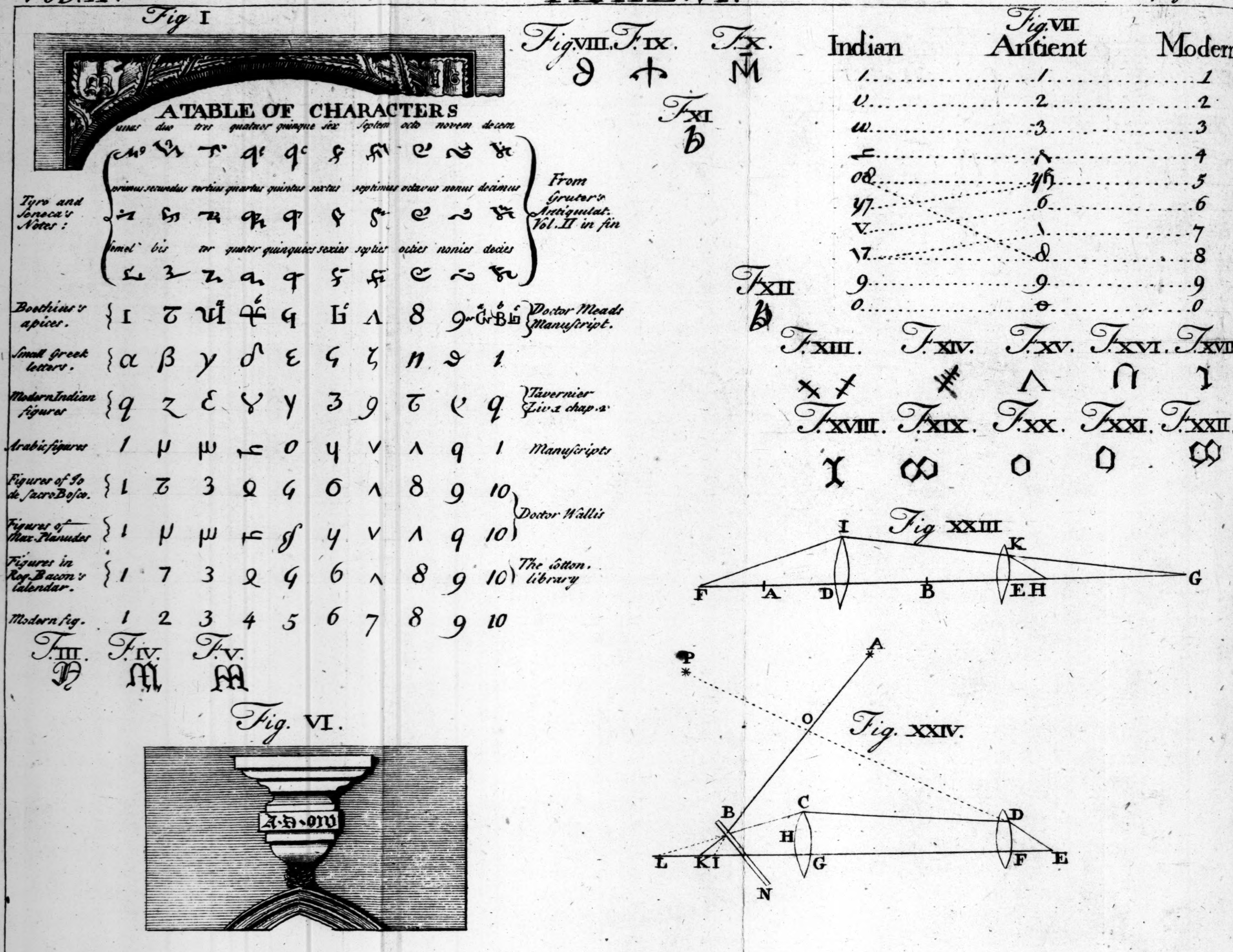
On *November* 12. we had considerable streaming at *Windsor* and likewise at *Bettna* and *Umea*; and on the 29th at *Læfanger*; and again at *Umea* on *Dec*. 24.

The Dr. having receiv'd the curious observations S. *Poleni* made at *Padua* for six years (vide *Phil. Trans*. N° 4[illegible] *p*. 201. & *seq*.) subjoins such of them as are conformable to his own.

A Ta



J. Smith del.



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A Table of the Rain at Padua, *in the Years*

	1725	1726	1727	1728	1729	1730
	Inch Dec.	Inch Dec.	Inch Dec.	Inch Dec.	Inch Dec.	Inch Dec.
Janu.	0. 521	1. 355	5 .955	4 .278	1 .085	0 .112
Febr.		1 .460	1 .073	1 .050	1 .245	2 .906
March	0 .889	3 .168	1 .878	4 .832	2 .902	4 .592
April	4 .019	3 .998	0 .498	1 .419	2 .768	1 .638
May	3 .625	1 .368	3 .530	3 .403	2 .634	4 .467
June	0 .036	2 .608	2 .476	2 .103	3 .134	6 .205
July	2 .297	2 .357	2 .930	4 .016	4 .526	2 .339
August	5 .185	1. 268	5 .067	5 .186	0 .578	4 .269
Sept.	2 .647	2. 900	4 .164	6 .948	3 .267	1 .090
Octob.	7 .104	0 .179	6 .576	5 .163	6 .994	5 .254
Nov.	3 .636	2 .277	5 .091	6 .836	4 .186	0 .534
Dec.	0.030	2 .390	7 .169	7 .599	2 .804	0 .894
Year	29.989	25.328	46.407	52.833	35.423	34.300

From this table M. *Poleni* obſerves, that the *Februaries* [we]re the drieſt months, and 1726 the drieſt year in all the ſix; [an]d that the *Octobers* were the wetteſt months, and 1728 the [w]etteſt of all the 6 years.

Farther alſo he ſaith, that in the 4 ſeaſons of the years (reck[o]ning their beginning from the 10th day of their reſpective [m]onths, *viz.* *December*, *March*, *June*, and *September*) leſs [w]et falls in winter and ſpring, than in ſummer and autumn; [a]nd that the wet weather increaſes, as the ſeaſons advance; that [i]n winter the wet is leaſt; that it increaſeth in ſpring; is [m]ore in ſummer; and moſt of all in autumn.

For proof of this M. *Poleni* hath made a table of the mean [q]uantities of the rain in the 4 ſeaſons of each of the 6 years; [th]e ſums of which 6 years rain are, as follows, in winter 39.490 [in]ches; in ſpring 52.188 inches; in ſummer 58.25 inches; and [i]n autumn 74.558 inches. But in the many years the Dr. ob[se]rv'd the weather at *Upminſter*, he finds it not ſo.

A Table of the highest and lowest Station of the barometer with the winds and weather in the

Year	Month	Day O. S	Barometer Highest	Barometer Lowest	Winds	Weather at the same time.
1725	Janu.	19	30.28		W	Fair.
	Dec.	8		28.56	S W 4	Cloudy.
1726	Nov.	28	30.18		N	Fair.
	Feb.	13		28.92	S W	Cloudy.
1727	Nov.	20	30.24		N W	Fair.
	Octob.	29		28.80	S 2	Cloudy.
1728	Dec.	2	30.20		N	Thin Clouds.
	Dec.	12		29.00	N W	Small Rain.
1729	Dec.	20	30.30		W	Somewh. cloudy
	Nov.	10		28.90	N	Rain.
1730	Dec.	20	30.40		N	Fair.
	Feb.	27		28.98	S E	Sunsh. with Cl.

From this table it appears, from the highest and lowest stations in the *6* years, that the greatest range of the barometer is 1. 84 inches; but at *Naples* it is only 94 centesimals of an inch; and what it was in other places the Dr. has given some account of in his remarks on 1727.

The illustrious observer hath also been very curious, and sedulous, in his observations of the thermometer. But the Dr. had not so much knowledge of his thermometer, as might enable him to compare his observations with his own.

S. *Poleni* hath also compared with his own, the quantities of rain, and the barometrical range observed at *Paris*, by M. *De la Hire*; and he finds that the rain at *Paris* is 16. 4 1/12 lines, and the barometrical range 2 5/12 lines more than that at *Padua*.

The last thing S. *Poleni* takes notice of is the magnetical declination, which he saith is 13 degrees west and hath decreased in the *6* years 10/60°; that every day there is a small alteration in declination: So that it doth not continue the same a whole day together; that the declination of all needles (especially

ally if touch'd by different magnets) is different a few sexa-
esms. But these niceties the Dr. recommends to the enquiry
f the curious; because they disagree with the observations of
Gilbert, and most of the magnetical writers.

Experiments and Observations on the light, produced by communicating electrical attraction to animate or inanimate bodies; together with some of its most surprising effects; by Mr. Stephen Gray. Phil. Transf. N° 436. p. 16.

THE several new electrical discoveries M. *Dufay* made, especially that important luciferous one, mentioned in a former *Transaction*, put Mr. *Gray* upon making the following experiments.

In spring 1733, as Mr. *Gray* had not any silk lines by him strong enough to bear the boy, he caused him to stand on some of the electrick bodies; and as he concluded, he found the effect the same, as mentioned by M. *Dufay*. He waves mentioning the particulars of the experiment; but proceeds to those that were suggested to him upon M. *Dufay*'s saying, that these snappings or sparks are not excited, if a piece of wood, or any other matter than a living body, be passed over the person suspended on the lines, unless it be a piece of metal: From hence he concluded, that if he suspended the metal upon silk lines, or laid it upon any of the electric bodies, the effect must be the same, when the metal had been made electrical by the tube, and the hand of any one was held near it; and he found it to succeed accordingly. He began first with some common utensils that were at hand, as the iron poker, tongs and fire-shovel; any of these being suspended upon lines of the largest sewing silk, and then the excited tube being applied first to the knob of the poker, and afterwards to the hand, there was the snap and pricking felt, as he expected; and the effect was the same, when the tube was first applied to the other end of the poker. He had by him a three pronged iron instrument, which was made many years before; it was designed for propping up the observatory table, when he observ'd the spots in the sun: The prongs were about $\frac{1}{2}$ an inch in diameter, two of them about 22 inches, and the third about 8 inches long, and pointed; this being laid either upon cylinders of glass, cakes of rosin, and bees-wax, or on a cake of sulphur, the tube being applied to the end of any of the legs, while the hand or cheek was applied near the other, both the other legs had the same effect, as that to which the tube had been

applied; but by holding his cheek near any of the points of the legs, the pricking or burning pain was much more sensibly felt, and was sometimes felt for several minutes after. He was not so inquisitive at that time about making the experiment in the dark, that he might see the light proceeding from the iron, not thinking that the electricity communicated to the metals would have produced so surprising phenomena, as by the following account of the experiments will be described.

As to the success in repeating M. *Dufay*'s experiment and Mr. *Wheeler*'s, we procur'd silk lines strong enough to bear the weight of his foot-boy, a good stout lad: Then having suspended him upon the lines, the tube being applied to his feet or hands, and the finger of any one that stood by held near his hands or face, he found himself prick'd or burnt, as it were, by a spark of fire, according to M. *Dufay*'s account, and the snapping noise was heard at the same time: But it did not succeed when we applied our hands to any part of his body through his cloaths, except upon his legs, upon which he felt the pain thro' his stockings, tho' they were very thick ones.

Being desirous to make the experiments upon another species of animals; we took a large white cock, and suspending him upon the lines first alive, the effect was the same as on the boy, whether we applied our fingers to any part of his body, or our cheek to his beck, comb or claws; then the cock was killed and put on the lines again, and we found very little, if any difference, from the effect it had on us when the cock was living: We then caused the cock to be stript of all his feathers, and the difference from what has been before said was not very considerable.

We took a large sirloin of beef, that came from an ox that had been kill'd two days before, and suspended it on the silk-lines: Then upon holding the fingers near any part of it there was a snapping, and the fingers were push'd or prick'd; but the snapping was thought not to be quite so loud, as when the experiment was made on the cock.

We caused to be made an iron rod, 4 foot long, and about half an inch diameter, pointed at each end, but not sharp, being left about the bigness of a pin's head; this was suspended on the lines; then the tube being rubbed, and held near one end of the rod, and then the finger or cheek, put near either end of the rod, the effect was the same, as when an animal had been suspended on the line, with respect to the pricking pain we felt.

At night we made the luminous part of the experiment, ſu-ending the iron rod on the ſilk lines; then applying one end the tube to one end of the rod, not only that end had a ght upon it; but there proceeded a light at the ſame time om the other, extending in form of a cone, whoſe vertex was the end of the rod; and we could plainly ſee that it conſiſt-d of threads, or rays of light, diverging from the point of e rod; and the exterior rays incurvated. This light is at-nded with a ſmall hiſſing noiſe; every ſtroke we gave the be cauſes the light to appear: The hiſſing ſeems to begin at at end of the rod next the tube; and as it comes, encreaſes in udneſs; but it is ſo ſmall as not to be heard without good tention, and by thoſe only that ſtand at the end of the rod om whence the ſaid light proceeds.

Mr. *Godfrey* being deſirous to ſee theſe experiments, Mr. *ray* repeated them, by laying a rod of iron upon a cake of hell-lac, which was laid upon a glaſs-veſſel; and the effects ere much the ſame with what has been mentioned above.

After his return to *London*, which was in *September* 1733, Ir. *Gray* cauſed to be made 3 iron rods, one 4 foot long, and wo, 3 foot long each; one of theſe was made tapering to-ards the ends, and pointed as that of 4 foot was; the other ointed at one end, and the other end not pointed, the diameter f the rods about half an inch; they were firſt forged, then l'd and burniſh'd. With theſe he made the following expe-iments: When any of them were laid upon the brims of hol-ow cylinders of glaſs well warm'd, or upon cakes of roſin and ees-wax, or upon thoſe of ſulphur, the phenomenon was the ame, as when they had been ſuſpended on ſilk lines: But now e diſcover'd a very ſurpriſing one, *viz.* that after the tube ad been applied, and the light ſeen at both ends, upon his oing to the other end of the rod, when there was no light to e ſeen, upon holding his hand at ſome diſtance from it, then moving his hand towards it with a pretty ſwift motion, there ſſued from that point of the rod a cone of light, as when he tube had been applied to the end; and upon repeating this motion of his hand, the ſame phenomenon appeared for 5 r 6 times ſucceſſively, only the rays were each time ſhorter han the other: theſe lights were attended with a hiſſing noiſe. That light which appears upon that end next the tube, when t is held obliquely to the axis of the rod, has its range tending owards it: All the time he is rubbing the tube, theſe flaſhes f light appear upon every motion of his hand up or down the

tube;

tube; but the largeſt flaſhes are produced by the motion of his hand downwards.

When 2 or 3 rods are laid either in a right line, or forming any angle with each other; or either touch, or are at a ſmall diſtance from one another, the tube being applied to one of their ends; the fartheſt end of the farther rod exhibits the ſame phenomena, as one ſingle rod does.

An experiment with the rod pointed at but one of its ends; when the tube is applied to the other end, the point exhibits the ſame appearance and a like effect with the rods, that are pointed at each end; but the great end of the rod, when the hand or cheek is applied near it, gives but one ſingle ſnap; but this is much louder than the greateſt of thoſe from the point of the rod, and one feels a little more pain by it.

He caus'd forge an iron ball, and then turn and burniſh it; it was 2 inches diameter, and placed on a wooden ſtand that had a ſmall concave on the top; in which the ball was placed: The ſtand being ſet upon a cylindric glaſs, then the excited tube being applied near the ball, there proceeded a ſtream of light from it, with a ſmall hiſſing noiſe: Then putting his finger or cheek near the ball, there was no ſnapping, nor any pain felt; yet there appear'd a very bright light.

The rod of 4 foot long, being placed upon a ſtand, that had a croſs arm with a groove in it to receive the rod; and then the ſtand being placed on the glaſs cylinder, they were ſet at ſuch a diſtance as that one of the points of the rod might juſt touch the ball over againſt its centre; then going to the other end of the rod with the excited tube, he applied it as uſual; when he came to the ball, the hand or cheek being near it, caus'd a loud ſnap, compared to thoſe made by the points of the rods, and the pain of pricking or burning was more ſtrongly felt, the light was alſo brighter and more contracted: He then placed the rod with its point at an inch diſtance from the ball, and applying the rod as before, he came to the ball, and touching it with his hand or finger, there not only appear'd a light on the ball, but there alſo proceeded a pencil of light from the point of the rod, after the ſame manner, as when the experiments had been made with the rods only.

The following experiment was made with the 4 foot rod and a braſs plate 4 foot ſquare: This was placed upon a ſtand; ſo that the plate ſtood perpendicular, the ſtand being ſet on the cylindric glaſs; then the rod with its ſtand and glaſs

ıaſs was ſet in ſuch manner that one point of it was about
ı inch from the centre of the plate; then the tube being
pplied to the other end of the rod, and after going to the
ate, on ſtriking it gently with his finger on the backſide,
light appear'd upon the plate, and at the ſame time the
encil of light came out from the point of the rod; and when
s hand or cheek was held near any of the angles of the
ate, there came a light from thence with a ſmall hiſſing
oiſe, and the pricking was felt, as when the experiments
ere made with the pointed rods.

A pewter plate being laid upon the ſtand, which had been
t upon a glaſs cylinder, applying the tube firſt and then the
nger, there appear'd a light upon the plate, and the end of
e finger was puſh'd; and when the cheek was held near
e edge of the plate, there was a ſnapping heard, but not
loud as when the iron rods were us'd. He then fill'd the
ate with water, and applying the tube and finger as before,
ere was the ſame light, puſhing of the finger and ſnapping,
when the experiment was made with the empty plate.
hen the experiment is made with water by day light, by
plying the end of the finger near the ſurface of the water,
appears to riſe in a little hill, and upon the ſnapping noiſe
lls down again, putting the water into a waving motion,
ar the place where the water had riſen.

He then took a wooden diſh, and placed it upon the ſtand,
ſt empty; then applying the tube and the finger near the
ſh, there appear'd a light, but no puſhing of the finger,
r ſnapping: He then fill'd the diſh with water, and the
be being held over the ſurface of the water, there appear'd
greater light than when the finger had been applied to the
npty diſh, but no ſnapping; till by holding the tube after
had been well rubbed, within 2 or 3 inches of the finger
at was held near the ſurface of the water; and then the
ger was puſh'd, and a ſnapping noiſe heard, as when the
periment was made with the pewter plate.

By theſe experiments we ſee, that an actual flame of fire,
gether with an exploſion, and an ebullition of cold water,
ay be produced by communicative electricity; and tho'
eſe effects are at preſent but *in minimis*, it is probable, in
ne there may be found out a way to collect a greater quan-
y of it; and conſequently to increaſe the force of this
ctric fire; which, by ſeveral of theſe experiments, ſeems
to

to be of the ſame nature with that of thunder and ligh
ning.

An Account of M. Seignette's Sal polychreſtus Rupellenſi *and ſome other chemical* Salts; *by M.* Geoffroy. Phil Tranſ. N° 436. p. 37.

M. *Seignette's ſal Polychreſtus Rupellenſis* is a *tartaru ſolubile*, compos'd of cream or cryſtals of tarta and the fixed ſalt of the *kali* of *Alicante*, well depurate This ſalt is very ſingular: For, tho' it be a fixt alcaline ſa it has the peculiar property of cryſtallizing, nor does it eaſil diſſolve in the open air, as other fixt ſalts do; but on th contrary calcines therein like vitriols or *Glauber*'s ſalt. An ther peculiar property, M. *Geoffroy* obſerv'd of it is, that it be ſaturated with a vitriolic acid, and the liquor be evap rated, there reſults a ſalt that reſembles *Glauber*'s ſalt, a has all the properties requiſite to make M. *Seignette*'s ſa In order to which;

Take of the ſalt of *kali* well depurated 1 *lb*, diſſolve in water, add thereto about 1 *lb. ſs.* of cryſtals of tarta boil the whole in order to diſſolve the cryſtals: But the ex proportion of cryſtals of tartar can be determined no mo in this operation, than in making the *tartarum ſolubil* either becauſe the ſalt of *kali* has retain'd more or leſs h midity in its cryſtallization, or becauſe the tartar has mo or leſs impurities in it. But if there be too much tartar the alcaline liquor, after the fermentation is over, filtrate t liquor, and as it cools, the ſuperfluous tartar will fall to t bottom. After the ſeparation of the tartar from the liqu evaporate the lixivium by a gentle fire, ſet it in a cool pl to cryſtallize, and you will have very fine cryſtals. If t liquor be evaporated a little too much, there will be no c ſtals of ſalt formed, but the liquor will be converted int hard tranſparent maſs, not unlike glue. But if you diſſo this maſs again, you may make it cryſtallize, as upon ſolving M. *Seignette*'s ſalt.

This ſalt purges very well, from one to two ounces, ſolv'd in a quart of water.

M. *Seignette*'s cryſtallized alcaline ſalt, is the ſalt of *k* that does not diſſolve in the air. M. *Geoffroy* was actuall work in perfecting this ſalt, in examining that of *kali*, comparing it with *borax*. From this laſt he extracts *Glaub*

lt, by mixing it with oil of vitriol. The mixture of borax ounces with one ounce and a drachm of vitriol, upon sublimation, gives the *sal sedativum*, described by M. *Homberg*; d the residue expos'd to a strong fire affords *Glauber's* salt. *Geoffroy* found out a method to shorten this operation: r, instead of subliming this salt, he gets it by crystallization in light foliated *laminæ*. This salt, whether sublimated, crystalliz'd, has the property of dissolving in spirit of wine; d if you set this spirit of wine on fire, its flame is green. irit of wine has no effect on *borax*; the oil of vitriol, disted with spirit of wine, communicates no greenness to its me; it is therefore requisite, that the *borax* be united with acid, in order to produce this green flame.

Sal sedativum made by crystallization crystallizes in a peliar manner: This operation is performed with 4 ounces of *rax*, 1 ounce and 1 drachm of concentrated oil of vitriol, most fixt and weighty that can be had. The *borax* is put o a glass retort, the oil of vitriol is pour'd on it, and then lf an ounce of common water. This mixture being exs'd to a fire, gradually increased, after the phlegm has s'd off, and even while it is a passing, there rise flowers, or volatile salt in very beautiful foliated *laminæ*, some of ich melt by the heat of the fire. After the operation, finest of these flowers, which are round the neck of the ort, are gather'd; and those that are grey are thrown upon remaining mass; which mass is dissolv'd in water, filtrat- and evaporated slowly. Sometimes even without evapoion, the shining talcous *laminæ* are to be seen in the uor. In 24 hours the liquor is pour'd off these *laminæ*; y are wash'd in fair water, set to drain, and then to dry a stove.

lf these crystals do not calcine in the stove, or in the sun, s a sign there is nothing crystallized but the *sal neutrum*: they do calcine, it is a sign that there is some *Glauber's* t mixed: And then this salt must be dissolv'd again in hot ter, and re-crystalliz'd. No body before M. *Geoffroy* ought of extracting this salt by crystallization, being always blimed hitherto.

An Account of a Machine *for changing the Air of the Room of sick People in a little time, by either drawing out the foul Air, or forcing in fresh; or doing both successively, without opening Doors or Windows; by Dr.* Desaguliers. Phil. Transf. N° 437. p. 41.

DECB (Fig. 1. Plate IV.) represents a case, containing a wheel of 7 foot diameter, and 1 foot thick; being a cylindrical box, divided into 12 cavities by partitions directed from the circumference towards the centre, but wanting 9 inches of reaching the centre; being open towards the centre, and likewise towards the circumference; and only clos'd at the circumference by the case, in which the wheel turns by means of a handle, fixt to its axis A, which axis turns in iron forks, or half concave cylinders of bell-metal, such as A, fixt to the upright timber or standard A E.

From the middle of the case on the other side behind A there comes out a trunk or square pipe, call'd the sucking pipe; which is continu'd quite to the upper part of the sick persons room, whether it be near or far from the place where the machine stands, in an upper or lower story, above or below the machine. There is a circular hole in one of the circular planes of the machine, of 18 inches diameter round the axis, just where the pipe is inserted into the case, whereby the pipe communicates with all the cavities; and as the wheel is turned swiftly round, the air, which comes from the sick person's room, is taken in at the centre of the wheel, and driven to the circumference; so as to go out very swiftly at the blowing pipe B, fixt to the said circumference.

As the foul air is driven away from the sick room, the air in the neighbouring apartments will gradually come into the room thro' the smallest passages: But there is a contrivance to apply the pipes which go to the sick room to the blowing pipe B, while the sucking pipe receives its air only from the room where the machine stands. By this means fresh air may be driven into the sick' room after the foul has been drawn out.

This machine would be of great use in all hospitals, and prisons: It would also serve very well to convey warm or cold air into any distant room; nay, to perfume it insensibly upon occasion.

Fig. 2. represents the inside of the flat of the wheel, which is farthest from the handle, and next to the sucking pipe

1, 2

2, 3, 4 repreſents the cavity or hole, which receives the air nd the axis, having a circular plate of iron round it to d all firm; which plate is made faſt to the wood and to iron croſs that has the axis in it; *ggg*, a prick'd circle, preſents a narrow ring of thick blanketting (which by preſ- g againſt the outſide caſe, whilſt it is fixt to the outſide of flat of the wheel) makes the paſſage into the wheel tight; H H is another circle of blanketting, likewiſe fixed to the tſide of the wheel, and rubbing againſt the caſe, that the violently driven againſt the inner circumference of the e may have no way out, but at the blowing pipe at B. ere is on the outſide of the other flat of the wheel, where handle is fixt, a ring of blanketting, like HHH, oppo- to it; but none oppoſite to *ggg*; becauſe the wood there ot open, but comes home cloſe to the axis.

Fig. 3. repreſents a vertical ſection of the wheel and caſe, ttle forward of the axis, drawn by a ſcale twice as large as t of the other 2 figures: A *a*, the axis ſupported by the ns A *a*, cylindrically hollow'd, excepting the upper part, ere a pin keeps in the axis; B D the caſe with the ſucking e S *a*; E A the prop for one end of the axis; 1, 2, the ening into the wheel; *gg* the eminence of the wood, to ich is fixed the ſmall ring of blanketting; the four black rks, one of which is near H, repreſent the ſections of the er two rings of blanketting.

Calculation of the Velocity of the Air, *mov'd by the new invented centrifugal* Bellows *of 7 foot diameter and 1 foot hick within; by Dr.* Deſaguliers. Phil. Tranſ. N° 437. p. 44.

WHEN the wheel revolves upon its axis (every revolution in this machine being performed by a man with y little labour in about half a ſecond of time) the air may conſider'd as divided into as many concentrical circumferences, as there are particles of air contain'd between the ſt and greateſt circle; conſequently, the centrifugal forces l be as the *radii*; that is in an arithmetical progreſſion.

t R = radius of the greateſt circle be 3. 5 foot
r = radius of the leaſt circle 0. 75
m = radius of the middle circle 2. 125

$$r + \frac{R-r}{2} = \frac{R+r}{2}.$$

$v =$ the velocity, or space, described in the middle circle in a second of time, upon supposition that the wheel performs 2 revolutions in a second. 26

$S =$ the space described by the action of gravity in a second of time. 16.

$s =$ the space that a particle of air receding from the cen would in a second of time describe by the action of the c trifugal force at the circumference of the middle circle.

$2\,m : v :: v\,s : s$; therefore, $\frac{v\,v}{2\,m} = s$ by *Huygens*'s rule. I

G and c express the force of gravity, and the centrifu force at the middle circle. Since the spaces described in same time by the action of 2 forces are as those forces, $s :: G : c$, and $\frac{s\,G}{S} = c$, and substituting in this expressi $\frac{v\,v}{2\,m}$ instead of s, we have $\frac{v\,v\,G}{2\,m\,S} = c$; and putting $\frac{R+r}{2}$ stead of its equal m, $\frac{v\,v\,G}{\overline{R+r}\times S} = c$. So that the ratio gravity to the centrifugal force, at the middle circle, is of G to $\frac{v\,v\,G}{\overline{R+r}\times S}$, or that of 1 to $\frac{v\,v}{\overline{R+r}\times S}$; which be multiplied by the number of the revolving circles R- gives for the pressure of the column of air $R-r$ proceedi from gravity $R-r$, and the pressure proceeding from centrifugal forces $\frac{\overline{R-r}\times v\,v}{\overline{R+r}\times S}$; wherein $R-r$ being a tor common to both may be thrown out of the expressi And since the velocities produced from different pressu are as the square roots of the pressures, the velocity wh gravity would give from the natural weight or pressure $R-r$ will be to the velocity which the same column wo have from the pressure occasion'd by the centrifugal force, $\sqrt{1}$, or 1 to $\sqrt{\frac{v\,v}{\overline{R+r}\times S}}$.

Lastly, since the velocity proceeding from the action gravity upon a column $= R-r$ is always a known quanti it may be call'd $= a$ (in this case equal to 15.38 foot *per* cond) and consequently, the velocity proceeding from the c

trifu

trifugal force will be $a \times \sqrt{\frac{vv}{\overline{R+r} \times S}}$, or $av \times \sqrt{\frac{1}{\overline{R+r} \times S}}$, or $\frac{av}{\sqrt{\overline{R+r} \times S}}$: That is, in this machine $\frac{15.38 \times 26.71}{\sqrt{4.25 \times 16.1}} =$ 49.67 foot *per* second. And if we add to this the velocity of the outer circle, in the tangent of which the air eſcapes, which in the ſuppoſition we made of 2 revolutions in a ſecond of time) is 44 foot *per* ſecond, we ſhall have it $= 93.67$ foot *per* ſecond.

N. B. This calculation ſuppoſes the bore of the ſucking pipe ſufficiently great to furniſh as much air as would eſcape, according to this velocity: But in this machine the ſucking pipe being no greater than the ajutage or blowing pipe, the velocity proceeding from the preſſure occaſion'd by the centrifugal force, and from the velocity in the tangent (which may be repreſented by a column of air of ſufficient height to give the velocity of 93.67 foot, which is 145.882 foot) muſt be divided into 2 equal parts, one half employ'd in ſucking, and the other in blowing; therefore, the half of 145.882 foot, which is 72.941 foot, will repreſent the height of a column of air, that would occaſion the ſame preſſure, with which the centrifugal force and the circular motion act in this machine; and a column of this height producing a velocity of 68.53 foot *per* ſecond. This number will expreſs the velocity with which the air is ſuck'd into the wheel; and the ſame number will likewiſe expreſs the velocity of the air out of the blower, proceeding from the centrifugal force, and the circular velocity of the outer circle, which is the real velocity of the ſtream of air out of the blower of this machine, *viz.* 68.53 foot *per* ſecond; which is at the rate of a mile in about 77 ſeconds, or about 7 miles in 9 minutes.

The Uſes of the foregoing Machine; *by the ſame.* Phil. Tranſ. N° 437. p. 47.

ONE of theſe centrifugal wheels is fixt in a room above the *Houſe of Commons*, to draw away the hot ſteam ariſing from the candles, and the breath of the company in the houſe, when it is very full, in warm weather; as alſo afterwards to drive in a ſtream of freſh air, to ſpread uniformly all over the houſe, by coming in at the middle of the cieling.

Beſides

Besides the uses of this machine for sick rooms and prisons, for warming, cooling, or perfuming any chambers at a distance; it may also serve in a man of war, to take away the foul air between decks, occasioned by the number of men in the ship, and to give them fresh air in a few minutes. In every part of the vessel every foul hole may be rendred wholesome, and even the stench and foul air from the surface of the bulge-water may be carried off. As to mines, the machine must prove of excellent use. For, as the damps, (either fulminating, which taking fire, destroy the men and ruin the works, or arsenical, which kill by their poisonous nature) are some specifically lighter, and some specifically heavier than common air; this centrifugal wheel can in a little time drive down air thro' wooden trunks, or launders, of 7 inches bore, in such quantities into the deepest mines, as to cause all the light damp to come out at the top of the pit; or by only altering 2 sliders, suck away all the heavy poisonous damp, whilst wholesome air goes down from above ground into the pit, so as to fill all the subterraneous caverns with fresh and wholesome air.

Likewise a great many of the difficulties, which attend the carrying on subterraneous passages for the conveyance of water from mines (call'd soughs, adits or drifts) may be remov'd by help of this wheel: For, the fresh air may be driven in a very little time to the place where the men are at work; tho' at the distance of 2, 3, or 4 miles: and therefore also to any intermediate space: Whereas the practice now is, either to make a double drift with communications between the two for the circulation of the air, or to sink perpendicular shafts or pits from the top of the hill over the adit; both which methods are very expensive, and will, (the doctor doubts not) upon trial, be out-done by the application of this machine.

The case of a cataleptic Woman; by Mr. Richard Reynell. Phil. Trans. N° 437. p. 49.

ONE *Anne Bullard*, a Servant maid, about 21 years of age, had for some time been irregular in her menses, and very much afflicted for the loss of a friend. *July* 10. 1730. she complained of a pain in her head, sickness in her stomach, with a general disorder; and she took *Gascoign*'s powder for a sweat: Next morning about 9 o'clock, she was found in bed, senseless, stiff, and void of feeling, with her eyes shut. When Mr. *Reynell* came, he found her in a true cataleptic fit, sense-less,

ſs, without motion, her limbs very ſtiff, but warm, and not ſily bent: But in whatever poſture any limb was put, continued in the ſame, whether erect or reclin'd: Her re-iration was good; but her pulſe low, and irregular: She d no catchings nor convulſive motions; but could, by no eans, be brought to herſelf. A vein was opened in the arm, d 12 ounces of blood taken away: ſhe bled freely, and me a little to herſelf, but could not ſpeak. He then gave her e following draught. ℞ *Aq. Menth. Rutæ, Bryon. Co. aa* j. *Sal. volat. Corn. C.* ℈ſs. *Sacchar. albiſſ.* ℈ij *f. hauſt.* d 5 ſpoonfulls at pleaſure of the following Julep. ℞ *Aq. Puleq. utæ, Menth. aa* ℥ij. *Aq. Brion. Co. Nephrit. aa* ℥iſs *Tinct. ſtor.* ʒij. *Sacchar. albiſſ. q. ſ. f. Julapium.* In a few ours ſhe came to herſelf; and upon asking whether ſhe knew w ſhe was taken? She replied, that ſhe had been reſtleſs d uneaſy till about 4 o'clock in the morning, when ſhe be-v'd ſhe fell into the diſorder ſhe was found in; but remem-r'd nothing that had happened beſides. She complained of dizzineſs in her head, with a violent pain in the fore-part of ſickneſs at her ſtomach, and ſhe was a little feveriſh. He ve her the following vomit at 4 o'clock in the after-on. ℞. *Aq. Cardui benedict.* ℥j. *Pulv. ipecacuanh.* ʒſs. *itriol. alb. depurat. gr.* vi. *oxym. ſcillit.* ℥iſs. *f. hauſt.* The mit work'd kindly, and ſhe ſeem'd reliev'd by it. About 6 lock in the evening another fit returned, much in the ſame anner as before; but ſhe ſoon came out of it; and then ſhe ok the draught with the volatile ſalt of hartſhorn, as before; d he applied a large bliſter to her back, and two more to r arms: About 9 the ſame evening ſhe had a ſtrong convul-n fit, with catchings, grinding of the teeth, and a great tre-or, neither of which ſhe had before: She had a ſtool the eceding night, but none that day. He gave her the follow-g draught at night going to reſt. ℞. *Tinct. Hier. cum vino ct.* ℥ijſs. *Aq. Ment.* ℥vj. *Sp. Lavend. Co.* ʒſs. *f. hauſt.* and e continued taking the draught, with the volatile ſalt, &c. ery 4 hours. *July* 12, ſhe had been light-headed all night, th little or no reſt; the bliſters were dreſſed, which diſcharg'd entifully, and the tincture had given her three ſtools in the ght, which had made her a little faint; her pulſe was low, d her water pale. He ſaw her in the evening, when ſhe had pt pretty well, after which ſhe was refreſh'd; the pain in r head but little, her ſtomach eaſy, and he found her in every pect better. The draughts were continued every 6 hours,

and

and when faint or ill, ſhe took of the above mentioned julep. *July* 13, in the morning he found her head eaſy, her water higher coloured: She was allowed broth and food of eaſy di-geſtion, which agreed very well with her: She ſat up in the afternoon, but was faint, and her head giddy; but when in bed ſhe was better: She had no ſtool that day. He gave her a draught with the volatile ſalt, *&c.* at night going to reſt, and the following purge next morning. ℞. *Tinct. Hier. cum vino fact.* ℥iſs *Syr. è Spinâ cerv. Aq. puleg. aa* ʒvj *Sp. La-vend. Co.* ʒj *f. hauſt. cum regimine cap. July* 14, the purge worked 5 times; ſhe eat a little dinner, and was eaſy: But upon walking about the room, her head was giddy, and ſhe trembled very much; but when in bed ſhe was better. He gave her the following draught at night going to reſt. ℞. *Aq. Rutæ, puleg. Bryon. Co. aa* ʒvj *Sp. Corn. C. opt. gutt.* 40. *Tinct. Caſtor.* ʒj *Sacchar. albiſſ. paululum f. hauſt. July* 15. ſhe complained when up of a numbneſs in her legs, and a prick-ing in them, like what happens when the legs are (as we com-monly call it) aſleep: Her appetite was better, and ſhe was in every reſpect mended. She took the following medicines. ℞. *Pulv. rad. Valerian. ſylv.* ℈ij *P. Caſtor. Ruſſ.* ℈j *Aſæfetid.* ʒj *Tinct. Caſtor. q. s. f. Maſſa pilular. cujus formentur pilul.* N° 40. of which ſhe took 4 twice every day with a ſmall draught of the following julep. ℞. *Aq. Ceraſ. nigr.* ℥ *Aq. Rutæ, Pæon. Co. aa* ℥ij *Sp. Lavend. Co.* ʒvj *Syrup. Ca-ryoph. q. s. f. Julap.* of which ſhe likewiſe took 5 ſpoonfuls at pleaſure. The bliſters were kept running as long as poſ-ſible; and when they were dried up, *July* 19, he gave her the ſame purge as before. *July* 22. ſhe had continued very well without any return of a fit; but upon cutting an iſſue in her arm, ſhe fell into a third fit, in which ſhe continued near two hours, but then came to herſelf and was well that evening. *July* 29. the purge was repeated. *Auguſt* 6. ſhe complained of a pain in her head, ſickneſs in her ſtomach, and ſome days before ſhe had a ſhew of the menſes, and had vomited near a pint of blood, and was coſtive: He then adviſed her to take 2 ſpoonfulls of *tinctura ſacra*, every night, or every other night, going to bed, as ſhe found it neceſſary, and 40 of the following drops. ℞. *Sp. C. C. opt.* ʒiij *Tinct. Helleb. nigr.* ʒv to be taken twice a day in cammomile tea. She took these medicines about 3 weeks, which anſwered expectation, and ſhe recover'd.

nnertus in Med. pract. lib. 1. *c.* 30 says, ' that a cata-
sis is a case so rare, that it is supposed hardly one physician
hundred has seen a cataleptic patient; therefore the histo-
of a catalepsis, when it happens, is carefully to be noted.'

Account of the Operation of the Fistula Lachrymalis; by . Francis Joseph Hunauld. Phil. Trans. N° 437. p. 54.

R. *Hunauld* remarks, that the intention in the operation of the *fistula lachrymalis* in destroying the *os unguis saccus lachrymalis*, thro' which the tears naturally distil the nose, is to procure them a new passage thither, by the thus artificially made: Wherefore in order to keep the s of this hole asunder, to prevent its filling up, and to render flesh, which forms its circumference, hard, and callous, as ere, a tent made of prepared sponge, &c. is put into this passage, and is continued therein a month or two. Notstanding this precaution, it happens but too often, that the s, instead of keeping the road prepared for them with care, flow over the lower eye-lid, as before the operation, occasion a weeping, which now becomes past remedy.

is easy to prove, that those very means, which are used r the operation to make the tears distil into the nose, generally the cause of the subsequent weeping: For by g the wound with small plegets, and putting a tent into hole that was made, the orifice of the little common ca- that serves to convey the tears into the *ductus lachrymalis*, rs a compressure, and is rendred hard, thick and callous; reby as its diameter is very small, it is easily stopped up. contusion made on this little orifice, and round about it, gs on a suppuration; after which the parts coalesce, and orifice of this small canal closes up. The *pus* or *sanies*, in the course of the distemper flowed back, both thro' the mon canal, and the small canals, which are a continuation the *puncta lachrymalia*, has sometimes occasion'd excoria- s; in consequence of which there happens a regeneration flesh during the dressings, a small matter of which is suffi- t to stop up such slender ducts. In fine, those small canals, ' which nothing passes for a month or two, that the dressings , either close by their proper springiness, or their diameters lessened by their small vessels becoming varicose. It is certain, t injections are sometimes made thro' the *puncta lachry- lia*; but the propelling force of these injections overcomes se resistances, which the cause, that naturally drives the tears

into the *puncta lachrymalia*, is not in a condition to get better of

Thus it appears from the detail of the accidents enumerated and which generally happen, more or leſs, that while the artist is endeavouring to preſerve a clear paſſage for the tears into the noſe, he labours, without deſigning it, to ſtop the entry of the upper part of their canal. The beſt way to avoid part of these accidents, and keep open the new canal from the eye to the noſe, is preciſely to do nothing. This is what experience has confirm'd, and what theory, well underſtood, will likewiſe give a clear conception of.

It is a thing not very eaſy to determine, how the tears, or the liquid that is continually found on the ſurface of the eye, in order to preſerve the cleanneſs and tranſparency of the cornea, can paſs thro' the *puncta lachrymalia*. It is moreover obſerv'd, that when one lies in bed, this liquid enters into the *puncta lachrymalia*, which in that poſition are higher than the eye, as well as into the *puncta lachrymalia* of the oppoſite eye. The aſcent of liquors in capillary tubes above their level, might be propoſed to explain this laſt fact. One might likewiſe in ſome circumſtances imagine that the road which the tears keep, to paſs from the eye into the noſe, to be a ſiphon, whoſe ſhort leg is divided into two. Theſe two ſimple ideas, however, are not ſufficient to account for the phenomenon under conſideration. The following *rationale* ſeems to the Dr. quite as ſimple, and more accurate.

The air preſent at the orifice of all the ducts, which have any communication with the *trachæa*, is by its proper weight determined to enter them, when the reſiſtance happens to be diminiſhed. Thus as, during inſpiration, it paſſes thro' the mouth and noſtrils, ſo it likewiſe enters the *puncta lachrymalia*: and muſt neceſſarily carry along with it, towards the *puncta lachrymalia* and their ſmall canals, the moiſture that lubricates the ſurface of the ball of the eye, as it mixes with it: It is therefore already eaſy to perceive, that in order to preſerve to the tears their new and artificial road into the noſe, one need only commit the whole care to the continual paſſage of the air and tears. It is well known in ſurgery, that it is very difficult, not to ſay impoſſible, to effect a re-union in a part that ſerves as an emunctory to a liquor conſtantly flowing to it.

Now let us examine, if nature alone can ſtop the hole made by the operation. It will not be imagined, that from the remains of a bony *lamina*, ſo thin as the *os unguis*, a ſufficient qu

of offifying juice can work out to ftop it up. The *perio-*
m and *faccus lachrymalis* are too much lacerated, to think
offible for them to repair of themfelves what they had loft.
r will it be believ'd, that the *membrana pituitaria* can eafi-
ill up the hole made in it. Thefe are the parts con-
ned in the operation: But even if they be granted to be
re difpofed to a re-production than they really are, ftill the
and tears will always be able to preferve themfelves a paf-
e into the nofe.

Wherefore, after having deftroy'd the *faccus lachrymalis*
l *os unguis*, inftead of introducing an extraneous body capa-
of making the orifice of the fmall common canal into the
ctus lachrymalis become callous, and of drawing on a
puration, the communication between the nofe and the eye
ft be left entirely difengaged; and liberty by this means be
en to refpiration, to make both the air alone, and the air
xt with the tears, to pafs continually through it.

In fine, the action of thefe fluids may be affifted by the ap-
cation of collyrium's, and by making frequent injections into
puncta lachrymalia; which, befides the common effects
t may be naturally expected from them, will contribute to
vent the juice, that re-unites the wound made in the skin,
m over ftreightning the canal.

e Caufe of the general Trade-winds; by Mr. Hadley. Phil. Tranf. N° 437. p. 58.

MR. *Hadley* thinks the caufes of the general trade-winds
not to have been fully explained by any of thofe who
ote upon that fubject, for want of more particularly and di-
nctly confidering the fhare the diurnal motion of the earth
th in the production of them: For, tho' this has been men-
ned by fome amongft the caufes of thofe winds, yet they
ve not proceeded to fhew how it contributes to their produc-
n; or elfe they have applied it to the explication of thefe phe-
mena, upon fuch principles as will appear upon examination
to be fufficient.

That the action of the fun is the original caufe of thefe
nds, all are agreed; and that it does it by caufing a greater
refaction of the air in thofe parts, upon which its rays fall-
g perpendicularly, or nearly fo, produce a greater degree of
at there than in other places; by which means the air be-
ming fpecifically lighter than the reft round about, the cooler
r will by its greater denfity and gravity, remove it out of its

place to ſucceed into it itſelf, and make it riſe upwar
But it ſeems this rarefaction will have no other effect than
cauſe the air to ruſh in from all parts into the part where
is moſt rarefied, eſpecially from the north and ſouth, wh
the air is cooleſt, and not more from the eaſt than the we
as is commonly ſuppos'd: So that ſetting aſide the diur
motion of the earth, the tendency of the air would be fr
every ſide towards that part, where the ſun's action is mo
intenſe at the time; and ſo a N. W. wind be produced in t
morning, and a N. E. in the afternoon alternately, on th
ſide of the parallel of the ſun's declination, and a S. W. a
S. E. on the other.

That the perpetual motion of the air towards the weſt ca
not be deriv'd merely from the action of the ſun upon it, a
pears more evidently from this: If the earth be ſuppos'd a
reſt, that motion of the air will be communicated to the ſu
perficial parts, and by little and little produce a revoluti
of the whole the ſame way, except there be the ſame qua
tity of motion given the air in a contrary direction in oth
parts at the ſame time, which is hard to ſuppoſe. But if th
globe of the earth had before a revolution towards the ea
this by the ſame means muſt be continually retarded: An
if this motion of the air be ſuppos'd to ariſe from any acti
of its parts on one another, the conſequence will be the ſam
For this reaſon it ſeems neceſſary to ſhew, how theſe phe
mena of the trade-winds may be caus'd, without the pr
duction of any real general motion of the air weſtwar
This will readily be done by taking in the conſideration
the diurnal motion of the earth: For, let us ſuppoſe the a
in every part to keep an equal pace with the earth in its d
urnal motion; in which caſe there will be no relative moti
of the ſurface of the earth and air; and conſequently, n
wind: Then by the action of the ſun on the parts about t
equator, and the rarefaction of the air proceeding therefro
let the air be drawn down thither from the N. and S. par
The parallels are each of them bigger than the other,
they approach to the equator, and the equator is bigger th
the tropics, nearly in the proportion of 1000 to 917; a
conſequently, their difference in circuit about 2083 mil
and the ſurface of the earth at the equator moves ſo mu
faſter than the ſurface of the earth with its air at the tropi
From which it follows, that the air as it moves from the tr
pics towards the equator, having a leſs velocity than the pa

f the earth it arrives at, will have a relative motion contrary to that of the diurnal motion of the earth in thoſe parts, which being combined with the motion towards the equator, N. E. wind will be produced on this ſide of the equator, nd a S. E. on the other. Theſe, as the air comes nearer to e equator, will become ſtronger, and more and more aſterly, and be due eaſt at the equator itſelf, according to xperience, by reaſon of the concourſe of both currents from e N. and S. where its velocity will be at the rate of 2083 miles in the ſpace of one revolution of the earth or natural ay, and above 1 mile and $\frac{1}{3}$ in a minute of time; which is reater than the velocity of the wind is ſuppos'd to be in the reateſt ſtorm, which, according to Dr. *Derham*'s obſervaions, is not above 1 mile in a minute. But it is to be conder'd, that before the air from the tropics can arrive at the quator, it muſt have gain'd ſome motion eaſtward from the urface of the earth or ſea, whereby its relative motion will e diminiſh'd, and in ſeveral ſucceſſive circulations, may be uppos'd to be reduced to the ſtrength it is found to be of.

Thus Mr. *Hadley* thinks the N. E. winds on this ſide of the quator, and the S. E. on the other ſide, are fully accounted or. The ſame principle as neceſſarily extends to the production of the weſt trade-winds without the tropics; the air arefied by the heat of the ſun about the equatorial parts being remov'd to make room for the air from the cooler parts, muſt riſe upwards from the earth; and as it is a fluid, it will hen ſpread itſelf abroad over the other air; and ſo its motion in the upper regions muſt be to the N. and S. from the quator: Being got up at a diſtance from the ſurface of the arth, it will ſoon loſe great part of its heat, and thereby acuire denſity and gravity ſufficient to make it approach its urface again, which may be ſuppos'd to be by that time it is rriv'd at thoſe parts beyond the tropics, where the weſterly winds are found. Being ſuppos'd at firſt to have the velocity f the ſurface of the earth at the equator, it will have a reater velocity than the parts it now arrives at; and thereby ecome a weſterly wind, with ſtrength proportionable to the ifference of velocity, which in ſeveral revolutions will be educed to a certain degree, as is ſaid before of the eaſterly winds at the equator. And thus the air will continue to circulate, and gain and loſe velocity by turns from the ſurface f the earth or ſea, as it approaches to, or recedes from the quator. From what has been ſaid, it follows,

1. That

1. That without the aſſiſtance of the diurnal motion of the earth, navigation, eſpecially eaſterly and weſterly, would be very tedious, and to make the whole circuit of the earth would perhaps be impracticable.

2. That the N. E. and S. E. within the tropics muſt be compenſated by as much N. W. and S. W. in other parts; and generally all winds from any one quarter muſt be compenſated by a contrary wind ſome where or other; otherwiſe ſome change muſt be produced in the motion of the earth round its axis.

An Account of the ſeveral Earthquakes, *which have happen'd in* New England, *ſince the firſt Settlement of the* Engliſh *in that Country, eſpecially of the laſt* Earthquake Oct. 29. 1727; *by Mr.* Dudley. Phil. Tranſ. N° 437. p. 63.

THAT *New England* is ſubject to earthquakes is certain; and we have had frequent accounts of it, ſince the firſt ſettlement of the *Engliſh* there, which is about 100 years preceeding 1727. The firſt and moſt conſiderable Mr. *Dudley* finds in hiſtory, and which ſeems to have been much like that on *Oct.* 29, 1727 (*vide* likewiſe an account of this laſt in *Phil. Tranſ.* N° 409. p. 124.) was on the 2d of *June*, 1638. This is ſaid (by the author, a Gentlemen of character and probity) 'to have been a great and fearful 'earthquake: It was heard, before it came, with a rumbling 'noiſe or low murmur like unto remote thunder; it came 'from the northward, and paſs'd ſouthward; as the noiſe 'approach'd near, the earth began to quake; and it came at 'length with that violence, as caus'd platters, tyles, *&c.* to 'fall down; yea, people were afraid of their houſes; the 'ſhock was ſo violent and great, as that ſome being without 'doors could not ſtand, but were fain to catch hold of poſts, '*&c.* About half an hour after, or leſs, came another noiſe 'and ſhaking, but not ſo loud nor ſtrong as the former. 'Ships and veſſels in the harbour were ſhaken, *&c.*' In 1658, there was another very great earthquake, but no particulars related. *Jan.* 31. 1660 there was a great earthquake. *Jan.* 26, 1662, about 6 o'clock at night there happened an earthquake which ſhook the houſes, caus'd the inhabitants to run out into the ſtreets, and the tops of ſeveral chimneys fell down. About the middle of the ſame night there was another ſhake; alſo in the morning following the earth ſhook again

gain: In 1665, 1668 and 1669, the earth was ſhaken; ince which we have alſo had ſeveral tremors of the earth, ut not very conſiderable, till the terrible earthquake *Oct.* 29, 1727, which terrified and amazed the inhabitants rom one end of the country to the other. As to the weaher that preceeded it: Our winter in *January* and *February* as very moderate, and excepting a few cold days, the weaher was pleaſant, and no great froſt in the ground. In the eginning of *March* there was a great deal of ſnow, and ome cold weather, which ſoon went over; and on the 11th 5 minutes after 4 o'clock, the ſun was eclips'd about 5 diits, as near as Mr. *Dudley* could determine without an inrument; after which to the end of the month there was leaſant weather, rain at times, and once thunder and lighting. *April* for the moſt part had fair pleaſant ſpring weaher, and a plentiful rain in the beginning and latter end of e month. The beginning of *May* was alſo pleaſant weaher; the 9th, 10th, and 13th, a great deal of rain; the 18th white-froſt; 24th and 25th cold weather; from that to the d of the month very dry. The beginning of *June* the me; abundance of thunder and lightning at times during e whole month. In *July* alſo, tho' we had ſome ſhowers in ifferent places, yet in general it was a very dry ſeaſon, d a great deal of thunder and lightning alſo this month; e 3 laſt days of it ſo exceſſive hot, that there was no workg or travelling by day, or ſleeping by night. The beginng of *Auguſt* was alſo exceeding hot, and in particular the ſt day at night from the evening to midnight we had a conued coruſcation or lightning all round the horizon; the e ſcarce ever remembred; it was really terrible; tho' the under was not ſevere. Dry weather continued to the 10th, d then we had a plentiful rain all over the province, but r hot weather held on to the end of the month; and till out the middle of *September* we had very hot weather: So at take it all together, Mr. *Dudley* never knew ſo much hot eather in any one ſummer in his time. On the 16. *Sept.* had ſuch a violent ſtorm from the north-eaſt, as was ner remember'd, for the fierceneſs and ſtrength of the wind; blew down houſes, barns, and a vaſt number of trees in orchards and woods; there alſo fell a great deal of rain the ſame time. In the month of *October*, preceding the rthquake, there was a pretty deal of cold weather; on the d a great deal of rain with a ſoutherly wind; on the 25th at

at night, a hard frost; on the 26th winterish weather, and a little snow; the 28th cold, the wind at north-west; the 29th the wind at north-west, tho' little of it, but cold: in the evening quite calm and a clear sky.

By this short journal of the weather the learned will be enabled, in some measure, to determine, how far our earth might be dispos'd to, or prepared for the earthquake that follow'd; first, by a long continu'd drought and excessive heat, whereby the earth became more porous, and abounded with exhalations or inflamed vapours, and which afterwards being shut up by the succeeding great rains and frost, and thereby hinder'd from an ordinary and easy passage thro' the pores and common vents of the earth, work'd so much the more terribly and forcibly on one another. But philosophers not being hitherto agreed on the nature or certain causes of earthquakes, Mr. *Dudley* comes next to enquire what sort of earthquake that on *Oct.* 29. was.

Gilbertus Jacchæus in his *Institut. physicæ, cap. terræ motu* distinguishes earthquakes into 4 species; wherein he agrees with *Aristotle* and *Pliny*, according to whom the first species is a shake or trembling, and by them liken'd to the shaking fit of an ague. Mr. *Dudley* could not hitherto hear of any breach or opening of the earth, thro' the whole extent of this earthquake. It was said by some that were abroad, that the earth sensibly rose up, and so sunk down again; but he much questions the truth of it: For, had there been any such succussion to raise the earth to any considerable height, the houses would certainly have tumbled down, or the exhalation have forced its way by some breach. Nor was our motion of the earth what *Aristotle* and *Pliny* call a pulse or an intermitting knocking, but one continued shake or trembling, and therefore, must be ranked under the first species, *viz.* a tremor or shake, without altering the position of the earth, and left every thing in the same state in which it found them, except the falling down of the tops of some chimneys, stone walls, &c. without doors; dishes and some other things within doors; as shall be taken notice of farther on.

That this earthquake was of the first species is also prov'd from the sound that accompanied it; since tremulous and vibrating motions are proper to produce sounds, which brings Mr. *Dudley* to the third particular, *viz.* the noise or sound that accompanied, or immediately preceeded this earthquake. This, indeed, was very terrible and amazing; tho' he is a-

think it was thought more conſiderable by thoſe within oors, than ſuch as were without in the open air. Some ook this noiſe for thunder; others compar'd it to the attling of coaches and carts upon pavements, or frozen round. One of Mr. *Dudley*'s neighbours liken'd it to the hooting out of a load of ſtones from a cart under his win-ow. For Mr. *Dudley*'s own part, being perfectly awake, ho' abed, he thought at firſt his ſervants, who lodged in a arret over his chamber, were haling along a trundle-bed: ut, in truth, the noiſe that accompanies an earthquake eems to be *ſonus ſui generis*, and there is no deſcribing it. This noiſe, as amazing as it was, in an inſtant of time, as ne may ſay, was ſucceeded by a ſhake much more terrible. His houſe, which is large and well built, ſeem'd to be queez'd or preſs'd up together, as tho' 100 ſcrews had been work to throw it down; and ſhook not only every thing in he houſe, particularly the bed under him, but the building ſelf, and every part of it ſo violently for the time, that he as really in great fear it would have tumbled down, and is family periſh'd in the ruin. But thro' the good provi-ence of God they receiv'd no harm.

As to the degree or greatneſs of the ſhake; this will be eſt known from its effects. Mr. *Dudley* has already men-on'd the falling of the tops of chimneys, diſhes from ſhelves, *hina*-ware, *&c.* doors unlatch'd, bells jangling, beds trem-ling, chairs moving, *&c.* A country farmer told him, he ad 40 or 50 rods of ſtone wall thrown down by it: And o' theſe effects be not very conſiderable, yet he cannot but e of opinion, that this earthquake for its ſpecies was as olent and terrible, as any we meet with in hiſtory: One of Ir. *Dudley*'s neighbours, that was walking home at the very ſtant, told him, the noiſe firſt brought him to a ſtand, and at during the ſhake, the earth trembled in ſuch a manner nder him, that he was ſo far from attempting to continue s walk, that it was as much as he could do to keep upon is legs, and he expected every moment the earth would ave open'd under him. Another that was riding home ſays, at upon the noiſe the earthquake made, his horſe ſtood ock ſtill, and during the ſhake, trembled to that degree, at he thought he would have fallen under him. The houſe ogs were likewiſe ſenſibly affected with the earthquake; me of them barking, others howling, and making ſtrange d unuſual noiſe. Nor was the earth alone affected with

this ſhake, but the ſea alſo in the harbours, and the ſhipping ſmall and great much mov'd with it. Mr. *Dudley* does no ſuppoſe it ever happens that earthquakes of this kind, o any extent, are equal or alike in all places; and accordingly he finds by information from the ſeveral towns, that th ſhake was much more moderate in ſome parts of the countr than others.

As to the time and duration of the ſhock: The *Boſto* news-papers fix the time at about 40 minutes after 10 o'clock at night; Mr. *Dudley*'s watch was not ſo much by 5 minute The 1. of *November* at midnight, which was 3 days after th earthquake, the moon changed. As to the duration of th firſt and great ſhock, whatever others may publiſh, he ca by no means ſuppoſe it exceeded the ſpace of a minute, if long; and after this in the ſame night there were 4 or 5 leſ ſer tremors; and at ſundry times ſince, the earth trembl in different places, even to the 13. of *November*, but withou any conſiderable effects or extent.

Laſtly, as to the courſe and extent of the earthquake: *Boſton*, the metropolis of *New England*, lies in Lat. 42 deg 25 min. N. and 4 hours 43 min. to the weſtward of *Londo* as the longitude was ſettled by Mr. *Brattle* of *New Englan* and Mr. *Hodgſon* of *London*; and making *Boſton* a centre, w have a certain account that this earthquake was felt in *Kenne beck* river to the eaſtward, and at *Philadelphia* to the weſt ward, 150 leagues diſtant from each other upon a W. S. W and E. N. E. courſe nearly; and no part of the intermediat country, that Mr. *Dudley* can underſtand, eſcaped the ſhake The colonies of *Rhode-Iſland*, *Connecticut*, and *New-Yor* that lie between *New England* and *Penſylvania* being a affected, tho' not equally, particularly at *Philadelphia*, ſmall ſhock. As to the oppoſite line or latitude, as we ma call it, of the earthquake; two noted iſlands to the ſou eaſt, called *Nantucket* and *Martha's Vineyard*, about 9 miles diſtant from *Boſton* (the firſt lying about 12 leagues in the ſea, diſtant from the main land) had the earthquak The *Engliſh* ſettlements towards the north-weſt, which hi therto did not exceed 40 or 50 miles from *Boſton*, had all them this earthquake very ſenſibly; and how far it migh reach beyond them towards *Canada*, could not hitherto b ſaid. By this calculation Mr. *Dudley* believes it will b found, that this earthquake was of a much greater exte than any hitherto taken notice of in hiſtory: As to the cour

f the earthquake, or where it firſt began, he could not hi-
erto determine by all the information he could get: For,
ey write from *Rhode-Iſland*, *Connecticut*, *New-York*, and
hiladelphia, all to the weſtward, that it was between the
ours of 10 and 11 at night. The ſame is likewiſe affirmed
om *Piſcatagua*, *Caſco-bay*, and *Kennebeck* river, which are
the eaſtward: So that hitherto it ſeems to him, that the
rth, thro' the whole extent aforeſaid, was ſhaken very
ar at the ſame time. Some of his neighbours are poſitive
at it came from the ſouthward; while others again are po-
ive, that where they were, it came from the north. But
is is not to be wonder'd at; ſince as Mr. *Dudley* ſuppoſes,
e ſubterraneous channels or caverns, thro' which the exhala-
on paſſes, are not in any one continu'd ſtreight line, but
anched out, and running upon all points of the compaſs,
pecially in ſuch a vaſt extent of land.

A neighbour of Mr. *Dudley*'s that had a well 36 foot deep,
out 3 days before the earthquake, was ſurpris'd to find
s water, that us'd to be very ſweet and limpid, ſtink to
at degree that they could make no uſe of it, nor ſcarce
ar the houſe when it was brought in; and imagining that
me carrion was got into the well, he ſearch'd the bottom,
t found it clear and good, tho' the colour of the water was
rned wheyiſh or pale. In about 7 days after the earth-
ake, the water began to mend, and in 3 days more it
urned to its former ſweetneſs and colour. Mr. *Dudley* was
ſo credibly informed, that ſeveral ſprings and good watering
aces were ſome of them lower'd, and others quite ſunk and
t with the earthquake. A Clergyman in a town about 20
les diſtant from *Boſton* aſſured him, that immediately
er the earthquake, there was ſuch a ſtink or ſtrong ſmell of
phur, that the family could ſcarce bear to be in the houſe
a conſiderable time that night. The like is alſo confirm'd
m other places. Perſons of credit do alſo affirm, that juſt
fore or in the time of the earthquake, they perceiv'd
ſhes of light. A Gentleman of probity from *Newbury*,
own, ſituated between 30 and 40 miles to the N. N. E. of
ſton, writes, that at 40 rods diſtance from his houſe, there
s a fiſſure of the earth, and near 20 cart-loads of fine ſand
own out where the ground broke, and water boil'd out
e a ſpring, and mixing with the ſand, made a kind of
agmire; but at the time of writing his letter, which was
21. of *November*, the ſpring was become dry, and the

 ground

ground clos'd up again. Since the receipt of this lett Mr. *Dudley* underſtood, that the ground where this ſand thrown up, and round about it for a conſiderable diſtance, i ſolid clay for 20 or 30 foot deep, and nothing like ſand ever be found there before: So that the exhalation forced this gr quantity of ſand thro' a very deep *ſtratum* of clay. He is al very well ſatisfied, that the earthquake was more violent in t towns to the north and north-eaſt of *Boſton*, than in thoſe to t ſouthward and weſtward; and in ſome of them that are rock the earth ſhook but a few days after.

An Extraordinary Effect of Lightning *in communicati Magnetiſm; by Dr.* Cookſon. Phil. Tranſ. N° 43 p. 74.

A Tradeſman of *Wakefield* in *Yorkſhire*, having put up great number of knives and forks in a large box; ſo in caſes or ſheaths, and others not, of different ſizes, and dif rent perſons making, in order to be ſent beyond ſea; and ha ing placed the box in the corner of a large room, there ha pen'd a ſudden ſtorm of thunder, lightning, &c. by which t corner of the room was damaged, the box ſplit, and a go many knives and forks melted, the ſheaths untouch'd. T owner emptying the box upon a counter where ſome nails l thoſe who took up the knives that lay upon the nails, obſer that the knives took up the nails. Upon this all of them w tried, and found to do the ſame, nay, to ſuch a degree as take up large nails, packing needles, and other iron thing conſiderable weight. Needles, or other things, placed upo pewter diſh, would follow the knife or fork, tho' held un the diſh, and would move along, as the knife or fork mov'd, with ſeveral other odd appearances, one of which that tho' you heat the knives red hot, yet their power is the ſame when cold.

Q. How the knives and forks came by this magnetic vir or how lightning ſhould be capable of communicating ſuc virtue?

A farther Account of the extraordinary Effects of the Lightning *at* Wakefield; *by the ſame.* Phil. T N° 437. p. 75.

THIS ſtorm of thunder and lightning happen'd the l end of *July*, 1731; and not only broke the glaſs iron frames of the croſs-chamber windows, but at the ſame

lit some studds in the corner of a wood-house; and passing to a room, likewise split a large deal box, which stood in e south corner of the room, where the lightning enter'd, and spers'd a great many dozen of knives and forks, which were t up in the box, all over the room.

Some of the knives and forks were melted, others snapped in nder; others had their hafts burnt; others their sheaths eier singed or burnt, and others not. But what was most rearkable, was, that upon laying them on a compter, where ere were iron nails, rings, &c. it was observ'd, that when y of them were taken up, there hung a nail or ring at the d of each of them: Most of them were tried, and found do the same.

One of the knives tho' made use of for almost a year and a alf to all manner of purposes, yet still retain'd the magnetic rtue to an extraordinary degree.

Fig. 4. Plate IV. represents an horizontal plan of the room, ox, and knives, and direction of the lightning; A the south ngle of the room; B the direction of the lightning; C the olar or magnetic line; D the box with the knives, lying in a irection parallel to the longer sides of the box.

Q. Whether the knives and forks lying in such a direction s either to coincide, or make but an acute angle with the agnetic line, might any ways contribute to their imbibing his magnetic virtue; since a bar of iron, placed in such a diection, shall in a little time receive a transient polarity; and it continue a long time in that position, a fix'd and permaent one?

Q. Whether the knives and forks lying in such a position, nd being violently heated by the lightning, might not, as hey cool'd, strongly imbibe this magnetic virtue: Since a ar of iron heated and placed in a certain direction to cool, vill sooner imbibe this power than in the same direction cold?

Q. The polarity of the compass has been alter'd by lighting, as may be seen in the *Philosophical Transactions*: Now ow should lightning be capable of communicating such a ower in this case; since it is plain that it has taken it away in nother.

The

The Description and Use of an arithmetical Machine, in*vented by* M. Christian Ludovicus Gersten. Phil. Tran. N° 438. p. 79.

SIR *Samuel Morland*, for ought M. *Gerstern* knows, was the first who undertook to perform arithmetical operations by wheel-work. To this end he invented two machines, one for addition and substraction; the other for multiplication, which he published in *London* in 1673, in small twelves. He gives no more than the external figure of the machines, and shews the method of working them. But as by this every one who has any skill in mechanics, will be able to guess, how the internal parts ought to be contriv'd; so it cannot be denied that these are two different machines, independent of each other; that the last, which is for multiplication, is nothing other than an application of the *Neipperian* bones on flat moveable disks; consequently, that his invention alone is not fit to perform justly all arithmetical operations.

After Sir *Samuel*, the celebrated M. *Leibnitz*, S. *Poleni* and M. *Leupold* took this undertaking in hand, and attempted to perform it after different methods.

The first published his scheme in 1709, in the *Miscellanea Berolinensia*; but then he only gave the outward figure of the machine. S. *Poleni* communicated his, explaining at the same time its internal construction, in his *Miscellanea* of the same year 1709. M. *Leupold*'s machine, together with those of M. *Leibnitz*, and S. *Poleni* were inserted in his *Theatrum arithmetico-geometricum*, published at *Leipsick* in 1727, after the author's death, yet imperfect, as is owned in the book itself.

Besides these, M. *Gersten* learned from several *French* journals that *Charles Pascal* invented one, which however he never had the sight of. The description of this machine is since publish'd by M. *Gallon* in his collection of machines and inventions, approved by the academy of sciences at *Paris*, (publish'd in *French* at *Paris*, *An.* 1735. in *quarto* in six tomes) in tome IV. p. 137; and likewise another by M. *Lespine* tom. IV. p. 131 and three more by M. *Hillerin de Boistissandeau*, tom. V. p. 103, 117, and 121.

M. *Gersten* took the hint of his machine from that of M. *Leibnitz*, which put him upon thinking how the internal structure might be contrived: But as it was not possible for him to hit upon the original ideas of that great man, an exact enquiry into the nature of arithmetical operations furnished him

n at last with others, which he express'd in a rough model wood, and shew'd to some patrons and friends, who encouged him to have another made of brass. But the want of an ificer, able enough to execute his ideas, made him delay till 1725, when he set about it, and finished the whole rk, fitted to a reckoning not exceeding 7 places. And in *ecember* of the same year he laid this machine before the ndgrave of *Hesse-Darmstadt*, and the hereditary prince his , to whom he demonstrated the mechanism of the whole inntion.

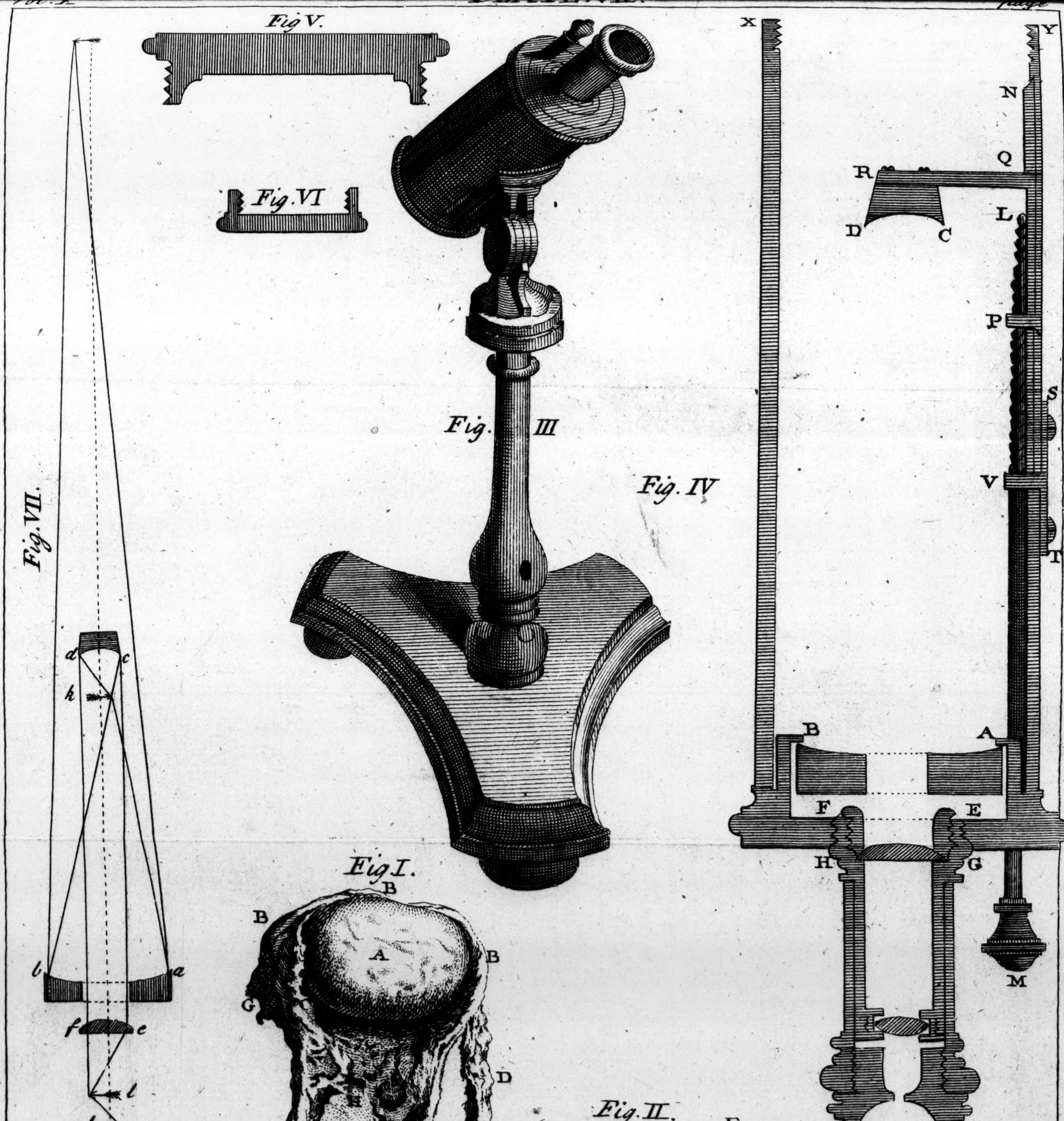
He owns that the gracious reception it met with from both ir highnesses, as well as the express recommendation of M. *Wieger*, one of the prince's privy council, would have been werful inducements for him to have published an account of machine; but for the uncertainty he was under, whether ssibly M. *Leibnitz*'s machine had not been brought to its rfection; in which case there is no doubt but the operation his machine, if it would really perform what is promised in description, would have been easier than M. *Gersten*'s; and nsequently preferable to it, provided its structure did not ove too intricate, nor the working of it take up too much ne.

But now being certain, that none of M. *Leibnitz*'s invenn has yet appear'd in such a state of perfection, as to have swer'd the effect proposed, and that these of M. *Gersten* fer from all those mentioned above, fancying at the same ne, that such as understand mechanics, will find it plain, acticable, and exact, in regard to its various effects, he kes no scruple to publish this invention, the product it is e of his younger years, with the several amendments he s since added to it; The particulars of which are as folws:

There are as many sets of wheels and moveable rulers as re are places in the numbers to be calculated. Fig. 1. ate V. represents three of them, by which one may easily ceive the rest; A A the first system or the figures of units, ording to its internal structure; B B and C C the 2d and system, *viz.* of tens and hundreds *a a a*, according to their ernal form. First, as to A A, where is a flat bottom of rass plate, which may be screw'd on, either upon a particuiron frame, or only upon a strong piece of wallnut-tree, bled with the grain cross'd. In this system are two movee rules gggg and *kkk*; the first of which he calls the

operator

operator, the 2d the determinator. There are besides, two wheel-works, the upper one is for addition and substraction; the lower one serves for multiplication and division. The upper one is provided first with *a*, an oblique ratchet-wheel of 10 teeth, of what diameter you please; on which, however, depends the length and breadth of the system itself. This wheel has a stop *r*, with a depressing spring *t*; under the wheel *a* is a smaller wheel *b* of the same shape. Both *a* and *b* are rivetted together, and fixed on a common axis. Under the wheel *b* lies a 3d *f*, which is a common tooth-wheel of 20 or more teeth, according as one pleases. It is larger than *b*, and smaller than *a*, turns about the same axis with the other two above it, and upon it is fixed a stop *c*, with the spring *d*, which catches the oblique teeth of the wheel *b*. Immediately under this wheel lies the upperpart of the operator, which may be best made of iron or steel. The wheels may be all made of brass, except the upper one. The operator is of the same thickness all over, and in its upper part are fixed as many round steel pins, as there are teeth in the wheel *f*, which are to catch the teeth of this wheel, and move it backwards and forwards. The height of those pins ought exactly to answer the thickness of the wheel *f*. The axis of the wheels *a* and *b* is kept perpendicularly by the bridge *e e*, which is screw'd to the bottom, as appears by the Fig. The operator *gggg* moves on the side, above, and in the middle in two brass grooves *i i i* and q q; about D it jets out, on which projection a piece of iron *h* must be well fastened, having a strong pin, on which the handle *z* fits, as may be seen in the system B B. The side itself D slides in another groove *s s*, and in its inner corner joins to it the determinator *k k k*, of the same thickness with the operator, the shape of which is sufficiently express'd in the Fig. This also slides up and down, on the one side in the groove *s s*, and *v* on the other side, where it is smallest, in a small piece 1, and where it is broadest above in the operator itself, which is either hollow'd out into another groove, or fil'd off obliquely. The sliding part of the determinator ought afterwards also to be fitted to it. Its chief part is the lock *u*, standing perpendicular on its broad part: It is drawn separately in Fig. 4. as at B B, on which is the sliding stop *c*, that is pressed down by its spring *d*, but rais'd by the tricker *a a*; that tricker has a pin *b*, on which is screw'd on the small handle *l l* (in the systems B B and C C, Fig. 1.) In the brass bottom A A (or *a a* Fig. 1.) you must file out 10 ratchet-teeth or kerfs, purposely for the stop



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f this lock, or which is better, you may insert into the brass ottom a small piece of iron, filed out according to this figure. The partition and length of these ratchet-teeth in the bottom must fit exactly with the circumference of the wheel *f*, (in the system A A, Fig. 1.) with this direction, that if the lock be kept by the uppermost tooth in the bottom, the operator cannot be mov'd at all; but when by pressing down the tricker *a* (Fig. 4.) the determinator is shov'd down, and is stopp'd by the 2d or 3d tooth in the bottom, the operator being likewise drawn down, as far as the determinator permits, makes the stop *c* (in the system A A, Fig. 1.) slide over one or two teeth of the second wheel *b*; consequently the same stop *c* must slide over 9 teeth, when the lock of the determinator will stand before the tenth tooth in the bottom, and the operator is pull'd down so far. If you have a mind to apply these ratchet-teeth on the out-side of the plate 2°, 2°, that covers the whole, you may fit the lock to it accordingly: But in this case the covering plate must be well fastened.

For multiplication and division, there is properly in each system but one wheel likewise divided into ten ratchet-teeth, on which is rivetted the round plate *l*, on which are engrav'd the numbers or figures. These wheels have no occasion for any bridge, but may turn about a strong pin of steel, solder'd to the bottom. The ratchet-wheel *m m* rests on one side upon the determinator, and upon a piece of brass of the same thickness, to which are fastened the stop *n*, and the spring *p*. Upon the operator is another stop *o*, with its spring; which stop has a small arm at *o*, which is check'd by a small studd, to hinder the spring's pressing the stop lower down than it ought: By which contrivance it is so order'd, that after the operator is slid down as far as it can go, in being slid up again, the stop *o* will turn but one tooth of the wheel *m m*. The round plate has in its middle a small hollow axis, on which are turned first two shoulders, and then a screw: This screw in the system A A is an ordinary one, winding from the left to the right.

But as each system ought to have communication with the preceeding one, tho' not with that which follows; to this end a projecting tooth of communication made of steel 3° is rivetted to the upper plane of the uppermost wheel *a*. This tooth must be placed exactly on the point of a tooth of the wheel, and by its revolution catches and turns every time but one tooth of the uppermost wheel of the preceeding system, sliding over the following one, (if there be any) without

touchin

touching it. For this reason the planes of the brass bottom in all the systems ought to incline a little. This will best appear from the vertical section, Fig. 2. (cut in Fig. 1. in the di rection from 5 to *f*) in which *a* is the brass bottom, H H th wood-bottom, *g* the operator, *i* the groove, *f* the 3d comm tooth-wheel, *b* the 2d wheel, *a* the first or uppermost ratche wheel, *e* the bridge, 2° the covering plate, and 3° the tooth communication. All these pieces are represented of the sam thickness; but every artist will easily know, where to add take off.

Fig. 5. shews the plan and true disposition of the teeth in th several uppermost wheels; that is to say, the parallel lines A and C D ought always to cut the brass bottoms (which are lik one another in length and breadth) length-wise into two equ parts: Then the perpendicular intersection E F will dete mine the centres *a* and *b* of the two wheels H and G. Th stop *r* ought every time to hold its wheel in such a manne that the points of two teeth coincide with the line A B C D. The obliquity of the teeth is the same in both, with th difference, however, that in G, which is a wheel of the syste A A (Fig. 1.) they are cut in from the left to the right, but H, (a wheel of the system B B) from the right to the left. Fo making the work more durable, the teeth are not to be c out into quite sharp points, but blunted a little, as in the whe H. The nicety of the whole machine chiefly consists in pl cing the centre *a* and *b*, or (which amounts to the same thin after having chosen the breadth of the brass bottoms in dete mining the diameter of the uppermost wheel: For, if th should prove so large, as that the two wheels H and G shou very near touch each other; the tooth of communication w be short, its operation will be of a small force, and the whe themselves will require a very great exactness, lest by turni about the wheel H, and the tooth of communication standi in the position, as represented in Fig. 5. a tooth of the wh H may touch it, and stop the motion. Whereas, on the oth hand, supposing the centres at the same distance, and the d meters of both wheels less, the tooth of communication will longer: Then such an exactness is not required in the whe yet more force is necessary for making the tooth of communi tion lay hold the better. Furthermore, it will be well to ma the undermost common tooth-wheel as large as you can.

From the construction of this first system, with which 3d, 5th, 7th, &c. entirely agree, one may easily imagine

d, 4th, 6th, 8th, &c. for every thing there is likewiſe the ſame, only that it is inverted: So that what in the firſt ſtands on the right hand, is in the ſecond on the left hand.

The plate for multiplication has on its hollow axis, as has been ſaid before, two ſhoulders; the lowermoſt of which is very ſmall, the ſum of its height, the thickneſs of the plate of the wheel *m m*, and of the operator, muſt amount to as much as anſwers to the height of the bridge *ee*. On both ends of the braſs-bottoms the two pieces of braſs 4°, 4°, of the ſame height, are rivetted on. This being done, at laſt the covering plates 2°, 2° is prepared and ſcrew'd on the piece of braſs 4°, 4°. If the machine be made pretty large, the covering plate muſt be ſcrew'd faſt, not only to the bridge *e e*, but likewiſe not far from the wheel of multiplication. It muſt be provided not only with round holes, thro' which are to go the axis of each uppermoſt wheel *a*, and the hollow axis of the plate *l*; but it muſt alſo have a long ſlit, in which the operator and determinator may be mov'd up and down; and laſt of all a ſmall window over the plate of multiplication, through which the figure or number engraved on the plate may appear diſtinctly. To the projecting ſcrew *l* of the plate *l*, is fitted an handle *f f*, joined to an index in the ſhape of a ſcythe. The ſcrew in the ſyſtem A A is a common ſcrew; conſequently the roundneſs of the ſcythe muſt turn from the left to the right: But in the ſyſtem B B, where it ought to be inverted, like all the other parts, the ſcythe muſt turn from the right to the left, as in the Fig. The uſe of this is to ſhew which way the wheels are to be turned; and the ſcrews are to prevent the machine's being hurt by unſkillful hands.

On the ſide of the determinator, *viz.* on that piece which cannot be preſs'd down, is alſo ſcrew'd a ſmall index, which may be directed to ſuch numbers or figures, as is required. Theſe figures are to be engrav'd in the covering plate, according to the Fig. and the diſtance depends on their ratchet-teeth *e* (Fig. 4.) in the braſs bottom.

On the axis of each uppermoſt wheel *a* (which axis muſt be made ſquare, as far as it projects over the covering plate) is fixed a thin round ſilver plate *x x* (in the ſyſtems B B and C C) or *a d* in Fig. 3. yet ſo as it may not rub againſt the covering plate. It has a hollow axis *b c* (Fig. 3.) on which is a right or left ſcrew, according to the ſyſtem it belongs to, and a ſmall ſhoulder *c*. To the ſcrew is ſcrew'd the handle *ſ s* (in the ſyſtems B B and C C Fig. 1.) which is vertically flat

 on

on the extremity, in order to turn by it the plate and wheels. The plate, as appears by the Fig. is divided by three concentric circles into two rings, in the outermoſt of which are engraved the numbers for addition; in the innermoſt thoſe for ſubſtraction. This plate only ſhall hereafter be called the ſilver plate; the firſt ring the addition-ring: the ſecond ring the ſubſtraction-ring: Moreover two indexes *w* and *y* are ſcrew'd to the covering plate; *w* ſhews the numbers of the outermoſt or addition-ring, and *y* thoſe of the ſubſtraction-ring. They have hinges, that they may be lifted up, and the ſilver plate taken out or put in again: Their curvature ſerves for a direction, which way the plates ought to be turned. A skilful artificer will be able to give them a neater and handſomer ſhape than in the draught, where the numbers are not cover'd.

All this being done, there remains now the figures or numbers to be engrav'd, in the following manner: Place each uppermoſt wheel *a* (in the ſyſtem A A) in ſuch a manner, that the tooth of communication be ready to catch (as in G Fig. 5) which may eaſily be felt. Obſerve in the ſilver plate, where the index *w* points; and there engrave the number or figure 9, lower down in the ſubſtraction-ring, where the index *y* points, engrave the cypher 0. After this divide both rings into 10 equal parts, one of which is already deſign'd for 9 in the addition, and another for 0 in the ſubſtraction ring: Then obſerve which way the wheel turns, if from the right to the left, as in ſyſtem B B: Then you muſt from the engraved number 9 in the addition-ring, towards the right, engrave 0 next; then 1, 2, 3, 4, &c. and in the ſubſtraction-ring alſo towards the right, from the already engrav'd 0, firſt engrave 9, then 8, 7, 6, &c. in an inverted order. But if the wheel turns from the left to the right, as in the ſyſtems A A and C C, you engrave the numbers or figures in the ſame order, but from the right to the left, as may be ſeen in B B and C C. Fig. 1.

In the multiplication wheels *m m* you muſt conduct the index *f f* exactly to the window, as it is drawn in the ſyſtem B B; mark the place on the round multiplication-plate under the window, and engrave upon it the cypher or 0; then make by two concentric circles a ring upon this plate, and divide this ring into 10 equal parts, and after the 0 (already engrav'd) engrave on the numbers, 1, 2, 3, 4, 5, 6, 7, 8, 9, in the ſame order as it was done in the addition-ring of the ſilver plate of the ſame ſyſtem. Laſt of all, if you think fit, you may ſcrew on thin ivory plates, to note upon them the numbers that are

to be calculated; particularly a long ſmall one on that ſide the ſlit of the determinator, where there are no numbers, and ewiſe two ſhorter broader ones, one under the window of ltiplication, the other above the ſilver plate. All this toge- r composes a machine, by the help of which you may per- m all the four arithmetical rules or operations. The way working it is, as follows:

1. As to addition: For inſtance, if you are to add 32 and ; becauſe the hindermoſt ſyſtem A A, in the Fig. which ght to repreſent the place of units, is not cover'd, let us e the ſyſtem B B for the place of units, and the ſyſtem C C the place of tens; turn the ſilver plates x x in theſe two ſtems, that the indexes w w point to the two numbers 5 d 9; then make the determinators, l l, l l, point alſo to 3 d 2: Next take one of the two operators, for inſtance, in B, and pull it down as far as you can, and move it upwards ain. This done, the number 1 in the ſilver plate in B B will me by this means under the index w, and the number 6 of ſilver plate in the ſyſtem C C under its index at the ſame ne, which is 61, the ſum 59 and 2. After this move the erator of the ſyſtem C C alſo up and down, when inſtead of 9 will come under the index; conſequently, you have 91 der the index's w w, which is the ſum required of 59 and 32 ded together. The reaſon of it is plain: For, by pulling wn the operator of the ſyſtem B B ſo far, the ſtop c of the wermoſt or common tooth-wheel f (*vide* ſyſtem A A) will de over two teeth of the middlemoſt ratchet-wheel b; and moving the operator up again, the ſame ſtop c will turn two ratchet-wheels a and b together, and cauſe the ſtop of the great or uppermoſt wheel a to ſlide over two teeth: t the ſame time the tooth of communication 3° will move rward one tooth of the uppermoſt ratchet-wheel in the ſyſtem C; conſequently, on the ſilver plate in B B, inſtead of 9, the mber 1; and in ſyſtem C C, inſtead of 5, the number 6 muſt pear under their indexes w w: And ſo for the ſame reaſon ving pulled up and down the operator of the ſyſtem C C, e number 6 pointed to by the index muſt be at laſt changed to 9.

2. As to ſubſtraction. Suppoſe 40 the ſum, from which you e to ſubſtract 24: Here you muſt put your ſum 40 in the ſub- action-rings; that is to ſay, turn the cypher 0 in the ſyſtem B, and the number 4 in the ſyſtem C C, under the indexes , as is repreſented in the Fig. Set the determinators at 24, as

as in addition; likewise move the operators only once up and down, the remainder 16 will appear under the indexes *yy*. As to the reason of this operation; when you consider, that the numbers in the substraction-rings are engrav'd in an inverted order, as is said before, you will find that it is the same as in addition.

3. As to multiplication: For instance; if you are to multiply 43 by 3, bring the 0 in all your addition-rings to the indexes, as also in all your multiplication-plates in the windows. Write down (which is more particularly necessary if the numbers be larger than in this instance) the multiplicand 43 upon the ivory plates near the 2 determinators in the systems BB and CC: But you may write the multiplicator 3 only on the ivory-plate under the window of the system BB. Set the determinators at 43; then move your operators successively as often up and down, till there appear in both windows the number 3, then you will see on your addition-rings under the indexes, the product 129.

It is easy to understand, that as multiplication is nothing else than a repeated addition, the machine does also perform its operation by a repeated addition only: For, the number which appears in the window of the system BB, shews how many times you have added the number 3, pointed by the determinator to itself, which, when done 3 times, is 9. And so the same number 3, which appears in the window of the system CC after your operation, shews how many times you have added the number 4 to itself. It is needless to observe, that besides the 2 systems BB and CC, there must be suppos'd another, not express'd in the Fig. which will shew the number 1 of the product 129.

4. As to division. If you are, for instance, to divide 40 by 3; set your dividend 40 in the substraction-rings under the indexes *yy*, in the system BB and CC; turn the indexes *ff*, *ff* near the windows to make 0 appear; write your divisor near the determinator of the system CC, and set the determinator at 3; pull the operator up and down, then you will have 1 under the index *y*, and 1 likewise in the window. By this you see, that you cannot work farther in this system CC; because you cannot substract 3 from 1: You must therefore, go on, to the other figure of the dividend, *viz.* 0, and in the system BB set the determinator again at 3: This being done, the first pulling of the operator up and down will produce 1 in the window, and 7 in the substraction-rings under

nder the index; and the number 1 which remain'd before the ſyſtem CC will be changed into 0. Now, as 7 is ore than 3, you muſt work on accordingly: Having done twice more, you will find that there remains under the index *y* but 1 (which is the numerator of your fraction) and elow in the two windows the quotient 13. When you conder that diviſion is nothing elſe but a repeated ſubſtraction, ou will alſo eaſily underſtand the reaſon of this operation.

For the clearer conceiving the method of proceeding with is machine in larger numbers, M. *Gerſten* explains it by the following examples.

Suppoſing there are ſix ſyſtems , *b*, *c*, *d*, *e*, *f*; let all the numbers ointed to by the indexes *ww* be in A B; thoſe which are to be pointed by the determinators, in CD; nd thoſe which are ſeen in the windows, in EF. Firſt of all, you muſt rn all your addition-rings of the lver-plates, and your multiplication-lates to 0, *viz.* that under all the dexes *ww*, and in the windows noing may appear but 0: Write the number 3563 near the eterminator, in the ſyſtems *a*, *b*, *c*, *d*, and direct them acordingly: The other number 58 you muſt likewiſe write own, but under the windows in ſyſtem *a* and *b*, as you ſee this ſcheme. Move the ſeveral operators, which are moveble, ſucceſſively as often up and down, till 8 appear below the windows, and you will have under the indexes above 8504, the product of 3563 × 8: And ſo the numbers of the achine will appear thus.

	f	*e*	*d*	*c*	*b*	*a*	
A	0	0	0	0	0	0	B
C			3	5	6	3	D
E	0	0	0	0	0	0	F
						5	8

Next advance your multiplicand 563 from the right to the left; hat is to ſay, place the determinar in the ſyſtem *b* at 3, in *c* at 6, in at 5, in *e* at 3; and reduce every umber in the windows to 0, except the ſyſtem *a*: As may be ſeen in he following ſcheme.

	f	*e*	*d*	*c*	*b*	*a*	
A	0	2	8	5	0	4	B
C			3	5	6	3	D
E	0	0	8	8	8	8	F
					5	8	

Then

	f	e	d	c	b	a	
A	0	2	8	5	0	4	B
C			3	5	6	3	D
E	0	0	0	0	0	8	F
					5	8	

Then pull all the operators agi successively in *b*, *c*, *d* and *e*, up an down, till 5 appear in the windo below, and you will find at last un der the indexes 206654, the produ of 3563 × 58.

	f	e	d	c	b	a	
A	2	0	6	6	5	4	B
C			3	5	6	3	D
E		5	5	5	5	8	F
					5	8	

	f	e	d	c	b	a	
A	2	0	6	6	5	4	B
C			3	5	6	3	D
E	0	0	0	0	0	0	F

But if you are to divide aga 206654 by 3563, you must place th dividend above in the substractio rings under the indexes. In th windows below every figure must b 0, in the same manner as in mul tiplication; and write the divisor under the dividend, accor ing to vulgar arithmetic, and as in the figure here annex'd.

If you direct the determinators in *e*, *d*, *c*, *b* to their num bers, and substract this divisor by pulling up and down th operators as often as you can, you will have in the window in *e*, *d*, *c*, *b* every where 5; but on the silver-plates there wi remain 28504. Now advancing your divisor from the left t the right, bringing to the windows in *d*, *c*, *b* all the cyphe 0, and working as before, there will at last appear on th silver-plates nothing at all, but below in the windows 5888 as may be seen in the following scheme.

	f	e	d	c	b	a	
A	0	0	0	0	0	0	B
C			3	5	6	5	D
E		5	8	8	8	8	F

And here you have only this t observe, that in such cases you c off all the hindermost figures numbers in E F, except that whi stands under the first figure of th divisor; what remains is your qu tient.

If it be objected that this machine cannot be fitted for many and long numbers, as one would please; because th multiplication of so many systems would require too grea force for one operator to move so many wheels, kept b

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rings, supposing that all the teeth of communication should
ly catch; M. *Gersten* owns that this objection is but too
ell grounded: However he cannot help observing at the
me time, that this defect can hardly be avoided, in any
ithmetical machine, for performing all those operations of
self, without the help of the mind: For there must cer-
inly be a particular system for each place of figures, which
to communicate with the next; consequently, as the sys-
ms increase in number, the force, requisite to move them
ll, must likewise increase. Besides, it ought to be consi-
er'd, of what size such a machine ought to be, which might
rve for common use. M. *Gersten* thinks few calculations
ould be requir'd, for which 14 or 16 systems might not suf-
ce. That which he made was of 7 systems, as has been
lready mention'd: The disposition of it was neither so well
ontriv'd, as he has explain'd it, nor were its several parts
well executed, as a good artificer might have done; yet
hose 7 systems were very easily put in motion: And if in a
achine for 14 figures, made by a skilful hand, it could not
e so easily practicable, this defect, he believes, might be
asily remedied, by applying the other hand in the 5th or 6th
ystem to the handle *ss*, in order to ease and assist the ope-
ator.

Of the Figure of the Earth *and the Variation of Gravity on the Surface; by Mr.* James Stirling. Phil. Transf. N° 438. p. 98.

THE centrifugal force, arising from the diurnal rotation of the earth, depresseth it at the poles, and renders it protuberant at the equator, as has been lately advanced by Sir *Isaac Newton*, and long ago by *Polybius*, according to *Strabo* in the second book of his *Geography*: But tho' it be of an oblate spheroidical figure, yet the kind of that spheroid has not hitherto been discover'd; and therefore Mr. *Stirling* supposes it to be the common spheroid, generated by the rotation of an ellipsis about its lesser axis; tho' he find by computation, that it is only nearly, and not accurately such. He likewise supposes the density to be every where the same from the centre to the surface, and the mutual gravitation of the particles towards one another to decrease in the duplicate ratio of their distances: And then the following rules will follow from the nature of the spheroid.

1. Let ADBE (Fig. 6. Plate V.) be the meridian of an oblate ſpheroid; DE the axis; AB the diameter of the equator, and C the centre: Take any point on the ſurface, as F, from which draw FC to the centre, FG, perpendicular to the ſurface at F, meeting CB in G, and FH cutting the line CG; ſo that CH may be to GH as 3 to 2. A body at F will gravitate in the direction FH; and that the mean force of gravity on the ſurface will be to the exceſs of the gravity at the pole above that at F, as the mean diameter, multiplied into the ſquare of the radius, is to one fifth of the difference of the longeſt and ſhorteſt diameters, multiplied into the ſquare of the co-ſine of latitude at F.

2. The decrement of gravity from the pole to the equator is proportional to the ſquare of the co-ſine of latitude; or which comes to the ſame thing, the increment of gravity from the equator to the pole is proportional to the ſine of latitude. Hitherto Mr. *Stirling* has conſider'd the variation of gravity, which ariſes from the ſpheroidical figure, while it does not turn round its axis: But if it doth, the direction of gravity will be in the line FG, perpendicular to the ſurface; and its variation now ariſing both from the figure and centrifugal force, will be 5 times greater than what ariſes from the figure alone; as will appear from the proportion of the lines FH and FG, the former being to the latter, as the whole force of gravity at F, while the ſpheroid is at reſt, to the force with which a body deſcends at F, while it turns round its axis.

3. From this laſt article it appears, that one fifth of the variation of gravity is occaſion'd by the figure of the ſpheroid, and the remaining four fifths by the centrifugal force. And whereas the earth could not be of an oblate ſpheroidical figure, unleſs it turned round its axis; nor could it turn round its axis, without putting on that figure: The diminution of gravity towards the equator, known by the experiments with pendulum's, prove both the rotation and oblate ſpheroidical figure of the earth.

4. The mean force of gravity on the ſurface is to the centrifugal force at any point F, as a rectangle under the radius and mean diameter to a rectangle under the co-ſine of latitude, and four fifths of the difference of the longeſt and ſhorteſt diameters. And at the equator, where the co-ſine of latitude becomes equal to the radius, the mean force of gravity is to the centrifugal force, as the mean diameter to four fifths

[...]ths of the longest and shortest diameters. This article is [fou]nd from the proportion of the lines F H and G H; the [for]mer being to the latter, as the force of gravity to the cen[tri]fugal force.

[5]. The proportion of the diameters of the earth will be [fou]nd in the following manner. The moon revolves about the [ea]rth in 27d 7^h 43′, or in 39343 minutes; and her mean [dis]tance is about 59 $\frac{1}{2}$ semidiameters of the earth, according [to] *De la Hire*'s and *Flamstead*'s tables, but near 60 $\frac{1}{2}$ semi[dia]meters by *Halley*'s. Mr. *Stirling*, therefore, takes 60 for [th]e mean distance, till it be better known: Then according [to] the nature of gravity, as the cube of the moon's distance [to] the semidiameter of the earth, or as 216000 to unity, so is [15]47870000, the square of the periodic time of the moon to [71]66, the square of the number of minutes, in which ano[the]r moon would revolve about the earth at the distance of [one] semidiameter: And as this last number to 2062096, the [sq]uare of 1436, the number of minutes in a sidereal day, so [is u]nity to 287.7; which would shew the proportion of the [cen]trifugal force at the equator to the mean force of gravity [(by] *Corol.* 2. *Prop.* 4. *lib.* 1. *Princip. Newton.*) were it not [for] the action of the sun on the moon: Therefore (by [Co]rol. 17. *Prop.* 66. *lib.* 1. *Princip.*) as the square of the side[rea]l year to the square of the periodic time of the moon, [tha]t is, as 179 to unity, so is 287.7 to 1.6, which being added [to] 287.7, makes 289.3. And therefore as unity to 289 (neg[lec]ting the fraction which is uncertain) so is the centrifugal [for]ce at the equator to the mean force of gravity on the sur[fac]e. And thence (by article 4.) as 289 to $\frac{5}{4}$, so is the mean [dia]meter to the difference of the longest and shortest: And [the]refore, as the axis is to the equatorial diameter; so is [23]07 to 2317; or in smaller numbers, as 231 to 232, the [sam]e as Sir *Isaac Newton* found in a different manner: For, [he] makes it as 230 to 231; and as 230 to 231, so is 231 to [23]2.004.

[6]. In the same manner the proportion of the diameters of [an]y planet may be found, if it have a satellite: For instance, [in] *Jupiter*, he turns about his axis in 9^h 56′, or in 596 mi[nut]es: And his third satellite revolves about him in 7^d 3^h 42′ [..]″, or in 10302.6 minutes, at the distance of 15.141 of his [sem]idiameters. Therefore, as the cube of 15.141 to unity, [so i]s the square of 10302.6 to 30579, the square of the num[ber] of minutes, in which a satellite would revolve about him

at the distance of his semidiameter. And as this last numb
is to 355216, the square of 596, so is unity to $11\frac{5}{8}$, or th
centrifugal force at his equator to the mean force of gravi
on his surface. There is no need of correcting this numbe
as in the former article; because the periodic time of *Jupite*
round the sun is vastly greater than that of his third satelli
round him. Mr. *Stirling* has chose the third satellite befo
any of the rest; because its greatest elongation was observ
by Dr. *Pound*, with a micrometer adapted to a telescope 1
foot long; and he also took the diameter of *Jupiter* by th
transit of the satellite, which is a much more exact way th
with a micrometer. But as the planes of *Jupiter*'s satelli
almost coincide with the plane of his equator, the diamete
determin'd by the transit of the satellite, is his greate
and the distance of the satellite, which ought to have be
given in his mean diameters, is assigned in his greatest: F
which reason the force of gravity, already found, must b
augmented in the triplicate ratio of his greatest diameter
his mean one; that is, if a represent the mean diameter, a
d the difference of the longest and shortest, in the proporti
of $2a + 3d$ to $2a$ very nearly. Hence, as the centrifu
force at his equator, to the mean force of gravity on his su

face, so is unity to $11\frac{5}{8} \times \frac{2a + 3d}{2a}$. And (by art.

$11\frac{5}{8} \times \frac{2a + 3d}{2a} : 1 :: a : \frac{4}{5}\,d$, or $20\,aa = 186$
$+ 279\,dd$; which makes a to d, as 108 to 10: And then
the axis is to the equatorial diameter, as 108—5 to 108+
or as 103 to 113; that is, as 12 to $13\frac{1}{6}$; which accurat
agrees with the observations both of Dr. *Pound* and Mr. *Bra*
ley, made with *Huygens*'s long telescope; the former maki
it as 12 to 13; and the latter as 25 to 27, which is ve
nearly the same. And if this theory agree so well with o
servations in *Jupiter*, there is no doubt but it will be mo
exact in the earth, whose diameters are much nearer
equality.

7. By experiments made at *Jamaica* (vide *Phil. Tra*
N° 432. p. 302.) in Lat. 18. with a very curious clock, contri
by Mr. *Graham*, it was found that the *London* pendulum w
slower there by 2′ 6″ in a sidereal day, than at *London*.
it was found by experiments made mith thermometers, that
were to be allowed for the lengthening of the pendulum
heat: and therefore it was retarded only 1′ 57″ by the dec

ent of gravity. So that while a pendulum at *London* makes 86164 vibrations, the number of seconds in a sidereal day, the same at *Jamaica* does only give 86047 vibrations. Therefore the force of gravity at *London* is to that in the latitude of 18 degrees, as the square of 86164 to the square of 86047; that is, very nearly as 1106 to 1103. And (by article 1, 2,) if a denote the mean diameter of the earth, d the difference of the greatest and smallest $a - \frac{ccd}{rr}$ will denote the force of gravity in general in any latitude, whose cosine is to the radius as c to r: Where if in the place of c there be substituted the cosines of $51° 32'$ and $18°$; that is of the latitudes of *London* and *Jamaica*, we shall have the force of gravity at the former to that at the latter, as $a - |\overline{387}\, d$ to $a - |\overline{9045}\, d$; that is, as 1106 to 1103. Whence the mean diameter of the earth will be to the difference of the axis and equatoreal diameter, as 191 to 1; and thence (by article 4.) as the mean gravity on the surface to the centrifugal force at the equator, so is 191 to $\frac{4}{5}$, or so is 239 to unity. In order to shew that this cannot be, Mr. *Sterling* observes, that when the moon's distance was supposed 60 semi-diameters of the earth (as in art. 5.) it was found that the mean force of gravity was to the centrifugal force at the equator, as 289 to 1. But if the proportion now found be true, the moon's distance at 60 semi-diameters must be augmented in the subtriplicate ratio of 289 to 239; and then it will become 64 semi-diameters. In like manner, if we compute the ratio of the mean force of gravity to the centrifugal force, by presupposing the magnitude of the earth, as Sir *Isaac Newton* and M. *Huygens* did, we must suppose a degree to be upwards of 80 *English* miles to bring it out 23. 91. Now whereas it is certain that the distance of the moon is about 60 semi-diameters of the earth, and that a degree is less than 70 *English* miles; therefore the conclusion, which seems to follow from the *Jamaica* experiment, cannot be allow'd to be true. And the experiments made by *Richer*, in the island of *Cayenne*, wou'd still make a greater difference betwixt the diameters of the earth, than those made in *Jamaica*: And the lengths of the *Paris* and *London* pendulums, compared together, would make it greater than $\frac{1}{231}$ part of the whole, as it was found in article 5.

8. From all the experiments made with pendulums, it appears, that the theory makes them longer in islands, than they

are

are found in fact. The *London* pendulum should be longer, when compared to the *Paris* one, than it really is: The *Jamaica* pendulum when compar'd to the *London* one, which vibrates in a greater island, should be longer than is found by experience; and the pendulum in *Cayenne* (a smaller island than *Jamaica*) should still be longer. This defect of gravity in islands is very probably occasioned by the vicinity of a great quantity of water, which being specifically lighter than land, attracts less in proportion to its bulk. And Mr. *Stirling* finds by computation that the odds in the pendulums betwixt theory and practice is not greater than what may be accounted for on that supposition. He also observes, that tho' the matter of the earth were entirely uniform, yet the hypothesis of its being a true spheroid is not near enough the truth to give the number of vibrations, which a pendulum makes in 24 hours. And suppose the true figure were known, the inequalities of mountains and valleys, land and water, heat and cold, would never allow theory and experiments to agree. But after the *French* Gentlemen, who are now about measuring a degree, and making experiments with pendulums in the north and south, shall have finished their design, we may expect new light in this matter.

Of the Mexican *filtre Stone; by Dr.* Abraham Vater. Phil. Trans. N° 438. p. 106. Translated from the *Latin.*

THIS Stone has got the name filtre from its porosity, whereby it lets liquors pass thro' it; and for this reason pots and mortars are made from larger pieces of it, to strain liquors, particularly water to drink: For, it is thought, that the water filtred thro' this stone is thereby freed from all its impurities, and becomes clearer and purer, and more wholsome. This is the reason that these stones are highly valued in *Japan*, and sold at the price of gold, because the *Japanese*, who know nothing of the stone or any other disorder in the kidneys, and who prefer health far before all other blessings, are of opinion, that these petrified *fungi* have the power of prolonging life, as may be seen in *historia filtri, lapidis in Valentini Mus. Museor. lib.* 1. *cap.* 22: For, this species of *fungus*, as related in *loc. citat.* grows on the rocks in some places of the Gulph of *Mexico*, about 100 elns under water, and spontaneously hardens and petrifies in the air. Dr. *Vater* will not take upon him to determine the origin of the filtre stone, nor manner of its growth, tho' both appears to be very suspicious, and invented purely to prevent its being thought a common

stone.

ne. For, *Lentilius, in ephemer. German. cent.* III. *Obs*
, writes that there are vessels made of two kinds of it; one
a dark grey colour like the *lapis Scissilis* from *Canada*, a
vince in *America*, and sold at a dearer rate; and others of
ophaceous colour, and of the growth of *Italy*. Nay, ac-
ding to *Le Clerc* in his physics, as appears by a note an-
ed, it is likewise dug up in the bishoprick of *Liege*, and
great use in *Holland*: Dr. *Ehrhart* of *Memmingen*, pre-
ed Dr. *Vater* with a choice collection of fossiles, among
ch was a *tophos* peculiarly porous, found about *Memmingen*,
which, as he assured him, would strongly imbibe water,
tever part of it was immers'd therein: For, no sooner is
surface of the water touch'd by it, but by the pressure of
atmosphere, the water ascends, and is carried quite thro'
porous substance, as we find by experience, in sugar, salt,
ing paper and sponge. And, this immediately suggested
hint, whether it might not be made use of instead of the
xican filtre to strain water. In order to try this, he made
ollow in a little bit of it, and upon pouring water
ein, he saw it strain very fast thro' its pores. He there-
proposed to try the same thing with other *tophi* and
s; and with this design he took the tophaceous tubes of
ocolla, and stopping one extremity, he poured water thereon;
it transuded very fast thro' its porous substance. He more-
recollected that he had a sponge for several years, which
n he lived at the *Caroline* bath, he had put in a pipe that
ey'd the hot waters, and by this means the sponge being in-
tated with the ochre, which the hot waters carry along with
and deposite in their passage, degenerated into a *tophus*:
made a pit in the sponge, and fill'd it with water,
t ran very fast through it. Upon this he resolv'd to make
with a *tophus* of the hot bath, of which he had a pretty
piece; and for this purpose he gave it a stone-cutter to
w into a mortar, to see whether the water would pass thro'
dense and solid stone: And it answer'd his expectation:
upon pouring water therein it strain'd through in the
manner as through the *Mexican* filtre and other *tophi*; but
ason of the density of the stone, slower than through more
s stones. The Dr. was pleased that he had by this expe-
t discover'd something that might contribute to illu-
the generation of the *Mexican* filtre under water: For,
the *tophus* of the hot baths is generated from the water
ting its ochre, in flowing thro' the pipes, and is insensibly
con-

concreted; he thought in like manner that the sea beating up the rocks deposits saline earthy particles, from whose successi concretion this stone is generated, and rather grows on th rocks, than like rock-mushrooms, springs from them; but fi the origin of this stone, as has been shewn above, is ve doubtful, and it does not manifestly appear, whether it be tak from the bottom of the sea, or rather dug out of the ea the Dr. will not take upon him to determine any thing abo it: But considering the remarkable density of the hot b *tophus*, thro' which notwithstanding water filtrates, he had mind to try the same experiment with the common stone m use of in building. The success answer'd expectation: For, mortar made of such stone served instead of the *Mexican* filt the water straining equally clear thro' both. The water stra ed in this manner acquir'd at first an earthly taste, which upon repeated filtration it lost; as *Lentilius* in *loc. supra ci* observ'd of the stone filtre: There is likewise no doubt, that other stones have the same effect; because the hard and most solid flint stones, with which streets are paved, bibe water, as we observe in rainy weather: Yet it is evid to any one, that the more solid and dense the stones are, the narrower their pores, the water pour'd on them will more difficultly and slowly pervade them:

But now we come to the virtue ascribed to this stone fil as that water strained thro' it is freed from all its impuriti For, thus we read in the above-cited history *in Valentini* *sæo*, that water filtred thro' it, tho' very clear when po therein, yet always deposites some little imperceptible d and becomes sensibly lighter, purer, and more wholeso nay keeps a much longer time without turning musty. W this the case, and could water be freed by this means f all heterogeneous particles, such filtres would deservedly very valuable: For, what conduces more to health than water in meat and drink. And yet vast tracts of the e are deprived of this blessing, where they have none, what is brackish, nitrous, vitriolic and aluminous, and pregnated with other mineral particles, which may occa several diseases. It seems entirely probable that w strain'd thro' such stone-filtres, deposites these impuri because we see, and experience confirms it, that springs bling up in sandy, gravelly places, and straining thro' s bottom, are much more limpid and pure than other spr But the purity of these waters is not owing to their filtr

o' the ſand and gravel and depoſiting their impurities
rein, but rather to their carrying none along with them:
, it is verified by chemical experiments, that not only
s, but likewiſe by means thereof other heterogeneous,
thy, ſulphureous, and mineral particles, diſſolv'd in the
ters, and cloſely united with them, can by no means be
arated from them by filtration: For, we obſerve that the
ſt ſolid minerals, as mercury, antimony, lead and other
nerals diſſolved, paſs thro' the pores of a paper filtre, and
afterwards ſeparated by precipitation from the waters,
l by repeated filtration remain in the filtre: But, it may
objected that a coarſe and denſe ſtone filtre is of greater
icacy in this caſe than a paper one: Yet the contrary ap-
rs from the waters that exſudate and diſtil from mines and
terraneous cavities, which immediately petrify, whence
ſes the ſtalactites. From this alone it appears, of what
le uſe the moſt ſolid ſtones, and conſequently, ſtone filtres
, to depurate water, and ſeparate the ſaline earthy and
ineral impurities, diſſolv'd therein. Yet the Dr. does not
ny, but that muddy and ſlimy waters may by ſtraining
ro' ſuch ſtones become clear and pellucid; becauſe theſe
purities do not diſſolve in the water or intimately incorpo-
te therewith, but only float therein. But beſides theſe, no
her waters can by any means become purer, as he learned
om repeated experiments, both with the filtre from *Hol-
nd*, and with thoſe made from the *tophus* of the Caroline
t baths and common ſtone, on ſeveral kinds of river and
ring water; and with an hygrometer examining their weight
th before and after filtration, he found little or no diffe-
nce. How happy, therefore, are the countries, to whom a
nd providence has given limpid and wholeſome ſprings of
ater, that require no ſuch filtres. But ſuch as are deprived
f this bleſſing, can do no better than uſe rain-water, as be-
g by diſtillation freed of all its impurities; and conſe-
uently the pureſt and moſt defecated.

l Halo *obſerved at* Rome Aug. 11. 1732; *by* S. De Revillas.
Phil. Tranſ. N° 438. p. 118. *Tranſlated from the* Latin.

FROM 3 o'clock in the forenoon till 4 in the afternoon a
ſimple halo, every way defined, and exactly circular,
as obſerv'd to ſurround the ſun in its pole; its breadth
eem'd to equal the apparent diameter of the ſun; the inner-
oſt colour was red, the reſt pretty dilute, and analogous to

those observed in the rainbow, but terminating in a whitish brightness, and somewhat changed about noon. Tho' the sky was serene, it was tinged with a thin darkness, a north wind blowing very gently. Afterwards the darkness condensed into whitish little clouds, while the halo vanish'd, whose diameter measur'd from the innermost edge of the zone 4 degrees.

The height of the barometer the same day was, as follows;

At 4 o'clock in the forenoon	—	27.	11 *Paris* inches
At noon	— — —	27.	10 ½
At 2 in the afternoon	— —	27.	10 ½.

An Account of an ancient Date *found at* Widgel-hall *in* Hertfordshire; *by Mr.* John Cope. Phil. Transf. N° 439. p. 119.

FIG. 1. Plate VI. represents an ancient chimney-piece (as Mr. *Cope* was informed) discover'd on pulling down part of *Widgel-hall* in *Hertfordshire*: There is cut upon it a date partly express'd in *Roman* numerals, and partly in *Indian* figures; which is the earliest instance he has met with of the *Indian* figures being used in *England*, *viz.* M. 16, or 1016; that at *Colchester* being *An.* 1090. vide *Phil. Transf.* N° 266. The carving is very fair, the letter M and the figures project out above ¼ of an inch. The whole chimney piece is of *English* oak-plank; and was very firm, tho' 718 years old and never painted over; it is 4 foot 3 inches and ½ long. The part under the figures 16 was broken off in taking it down in *Aug.* 1733, when the house was on fire.

Remarks on the aforesaid ancient Date, found on an Oaken Plank *at* Widgel hall *near* Buntingford *in* Hertfordshire, *now preserv'd in the* Musæum *of the* Royal Society; *by Mr.* John Ward. Phil. Transf. N° 439. p. 120.

APRIL 4, 1734, a curious draught of an ancient date carv'd in an oaken-plank at *Widgel-hall*, the seat of Mr. *Gulston*, was laid before the *Royal Society*, as the most early instance of our common figures, usually call'd *Arabian*, which had ever been observ'd in *England*. It was read M 16, and thought to express the year 1016: the M being taken for a *Roman* numeral, and the 16 for *Arabian* figures.

Dr. *Wallis* had in 1683 communicated to the *Royal Society* the draught of a mantle tree, somewhat like this, which he saw

y at the parsonage-house at *Helmdon* in *Northamptonshire*. he date, which was likewise carv'd in mix'd characters expess'd the year M 133, as the Dr. read it: This being the dest monument of that sort, which had then been discor'd among us, was first publish'd in *Phil. Trans.* N° 154, d afterwards in the Dr's *Algebra, cap.* 4. *p.* 14.

An. 1700, another draught of a date at *Colchester*, which d been sent to Dr. *Wallis* by Mr. *Luffkin* (who copied it om the under cell of a wooden window, and read the ures 1090, being all *Arabian*) was likewise publish'd in e *Phil. Trans.* N° 266, as more ancient than the former.

None earlier than these 2 last had hitherto appear'd, till at from *Widgel-hall*: Upon the sight of which Mr. *Ward* ought the reading given to it look'd very plausible. The ixt characters were no just objection, which Dr. *Wallis* had counted for in the *Helmdon* date *Phil. Trans.* N° 266, and r. *Ward* himself observed in some manuscripts: But still e difficulty seemed to remain, which was the want of some aracter in the place of hundreds: And therefore, soon ter going into *Hertfordshire*, he took that opportunity to ait upon Mr. *Gulston*, in order to see the original, which was me time after presented to the *Royal Society*, together with letter giving an account of the antiquity of the building in hich it stood. And as that letter may afford some light to e enquiry about the date cut in the plank, it is as follows.

Part of a letter from *Francis Gulston* Esq; to Mr. *John Ward*.

Sir,

'I can give you no further account of the antiquity of the building, than that in general it was esteemed ancient. Before the house was burnt, on the timbers there were several old coats of arms; some we look'd on as belonging to the family of the *Scalers*, who were possessors of *Widdihale* with other estates soon after the conquest.

" *Widdihale* in *Hertfordshire* in the time of the Conqueror was parcel of the estate of *Hardwin de Scalers*, as appears by *Domesdeibook*, fol. 141. It continued in that family for several generations, till it came to *Anthony Widvile*, by the marriage of the daughter and heir of *Scalers*. But when he would not comply with *Richard* III. to destroy the young Princes, all his lands were seised, and the Manor continued in the Crown, till *Henry* the VIII.

 granted

" granted it to *George Canon* and *John Gill*: *George Gill*
" the son of *John*, marrying the daughter of *George Canon*
" obtain'd the whole. In this family it continu'd till the be-
" ginning of the reign of *James* I. when it was sold to *John*
" *Goulston* Esq; whose descendants now hold it. *vide Sir*
" *Henry Chauncy's hist. and antiquit. of Hertfordshire*
" p. 111."

' The house of *Widdihale*, probably, might have been of
' greater antiquity, and I believe really was: For, at the
' time of the conquest it was in the possession of a consider-
' able follower of *Harold*.

' The piece of timber I send you was the top of a door-
' way, in a timber-built house, and plaister'd over with mor-
' tar. From the date on the plaister'd wall, the door had no
' been us'd at least 344 years: For, on the outside wa
' plainly to be seen the date 1390. Part of the room th
' was found in was burnt too much to repair again: And i
' taking down the burnt timbers, being present myself, I ac-
' cidentally saw it, and observing the date, thought it a cu-
' riosity, that might give to the curious some speculation

I am, &c.

' *Woodbridge* in *Suffolk*
' *July* the 14, 1734.'

Francis Gulston

Upon considering the characters on this plank, and those the other 2 dates mention'd above, together with the accoun given by learned men of the time, when the *Arabian* figure were first introduced into these parts of the world, and th various forms they have since receiv'd, as represented Fig. 2. Mr. *Ward* was at last satisfied, that none of these dates prove they were ever us'd among us, in less than 10 years after the reading given to the latest of them. And th reasons which led him into this opinion, he now begs lea to offer, after having first briefly enquir'd into their orig and antiquity.

Most writers, who have treated of the rise of these figur have thought that they came first from the *Persians* or *Indi* to the *Arabians*; and from them to the *Moors*; and so to t *Spaniards*, from whom the other *Europeans* receiv'd the This was the opinion of *John Gerard Vossius*, de Naturâ a lib. 3. cap. 8. § 6. Mr. *John Greaves de siglis Arabum & Pe sarum astronom.* p. 2. where the form of them may be see

Bisho

ſhop *Beveridge*, *Arithmet. Chronolog. lib:* 1. *cap.* 5. Dr. *Wal-*, *de Algebra cap.* 3. *p.* 10. and many others. And the *rabians* themſelves own they had them from the *Indians*; both Dr. *Wallis ibid.* p. 9. and Mr. *Greaves*, *de ſiglis Ara-m*, &c. have ſhewn from their writers.

But *Iſaac Voſſius* thought the ancient *Greeks* and *Romans* ere acquainted with theſe figures; and that the *Arabians* ok them from the *Greeks*, and the *Indians* from the *Ara-ns*, *Obſervat. ad Pomp. Mel.* p. 64. For the proof of this refers to *Tyro* and *Seneca*'s notes, *Grut. inſcript. Vol. II. fin.* and *Boethius*'s treatiſe *de geometria*, *lib.* 1. *ſub fin.* t as to the notes of *Tyro* and *Seneca*, they ſeem to have no inity with theſe figures, either in their number or nature: r, they are not limited to 9, but many times that number, d all different in form. Nor are they ſimple ſigns of num-rs, but complex characters of ſeveral letters of thoſe nume-l words, which they ſtand for in the *Roman* language, like r ſhort-hands; and therefore vary in their ſhape, as they e deſigned to expreſs cardinals, ordinals, or adverbs of mber. This will appear by the table of characters ig. 2.) in which are repreſented the firſt ten of each. But to what *Voſſius* ſays concerning *Boethius*, Mr. *Ward* ob-rv'd in a curious manuſcript of that writer, now in Dr. *Mead*'s library, 9 characters, which he tells us were invented d uſed by ſome of the *Pythagoreans* in their calculations; hile others of them made uſe of the letters of the alphabet r the ſame purpoſe. *Boethius* calls them *apices* or *charac-res, ubi ſupra*: Theſe are alſo inſerted in Fig. 2. to ſhew e great affinity between them and the *Arabian* figures, as eſe latter were written 2 or 3 centuries ago.

The opinion of *Daniel Huetius* differs from either of the rmer: For in *Demonſtrat. evangel. prop.* iv. c. 13. p. 172. e imagined, that the *Arabian* figures were only the letters f the *Greek* alphabet, corrupted and alter'd by ignorant *Librarians*.

From this ſummary account of the riſe and antiquity of eſe figures, it ſeems probable to Mr *Ward*, they might owe eir original to the *Greeks* (thoſe common Maſters of all ience) and paſſing from them firſt to the eaſtern nations, ome round to theſe weſtern parts, in the manner before de-ribed. We have no other author who ſpeaks of this matter, ear ſo ancient as *Boethius*, whoſe words are very expreſs, nd greatly ſtrengthen'd by the ſimilitude of his characters with

with the *Arabian* figures. And therefore, we may rather suppose, they took their rise from these than from the small *Greek* letters, with which *Huetius* compared them; since these latter are neither so like them, nor so old as the time of *Boethius*. And tho' what the *Arabians* say may be true, that they had them from the *Indians*, and not the *Indians* from them, as *Isaac Vossius* conjectur'd: Yet it may be equally true, that the *Indians* had them first from the *Greeks*, and those *Arabian* writers (who are not very ancient) not have known it; nor are there any *Indian* monuments of sufficient antiquity to render this opinion questionable.

But whichsoever of these sentiments may be esteemed the most credible, with respect to the origin of these figures; *Joseph Scaliger lib.* 3. *ep.* 113. thought they were not receiv'd by the *Europeans*, as they came of later ages from the *Arabians*, long before the year 1300.

But *John Gerard Vossius de natur. Art. lib.* 3. *cap.* 8. § 7. was of opinion they began to use them about the middle of the thirteenth century, or the year 1250.

F. *Mabillon*, in his treatise *de re diplomatica*, was necessarily led to attend to the use of these figures, particularly in dates. And he informs us, that they were rarely used before the fourteenth century, except in some few books of geometry and arithmetic. And presently after he says, *lib.* 2. *cap.* 28. § 10. it was not much to his purpose to treat of them; since he did not design to carry his work lower than the thirteenth century. By which he seems to intimate, that he had met with very few, if any, instances of *Arabian* figures, in such instruments at least, before the year 1300.

But no one appears to have examin'd this subject more carefully than Dr. *Wallis*, who has offer'd some arguments to prove, that *Gerbertus*, a monk, who was afterwards advanced to the Papal see, and took the name of *Sylvester* II. had before the year 1000 learn'd the art of arithmetic, as now practis'd, with the use of 9 characters only (whatsoever their form then was) from the *Saracens* in *Spain*, which characters he afterwards carried into *France*, *de Algebra* c. 4. p. 1[illegible]. But the Dr. thinks those characters or figures were known for a long time after only to such artists, and principally used by them in astronomical calculations; the *Roman* numerals being still retained in common use to express smaller numbers, *ibid.* *p.* 11, 15, 16. Nor has he given us the figures us'd by any of those writers, before *Johannes de Bosco sacro*, who died in the

e year 1256; and *Maximus Planudes*, a *Greek*, who flou-
h'd after him; which Mr. *Ward* has copied from him, and
serted in Fig. 2.

Mr. *David Casley*, in his *Catalogue of the Manuscripts of*
e King's Library, &c. has publish'd a specimen of manu-
ripts from the *Cottonian* library, call'd *Calendarium Rogeri*
acon, Pl. XV. and dated 1292. The figures in this book
e *Arabian*; and as Mr. *Casley* informed him, the oldest
at he remembers to have met with in either of those libra-
es: For which reason Mr. *Ward* has given them a place in
ig. 2.

It appear'd to Mr. *Ward* exceeding difficult, how to recon-
le the opinions and observations of these several writers,
ncerning the first use of the *Arabian* figures in these western
untries, with the time assigned even to the latest of the
tes above-mentioned: And it could not but seem very
range, that no date of any writing should have been pro-
ced in those figures, or any other use of them discovered
xcept perhaps in some mathematical calculations, or books
arithmetic) long before the fourteenth century: And yet
at a date should be found, so carv'd in a piece of wood,
fore the middle of the twelfth century, for so common a
rpose as the mantle-tree of a chimney.

But upon a closer examination of the characters he found
ason to think, this was not really the case; and that instead
1133, they ought to be read 1233, what has been taken
r 1, being designed for a 2. This reading seems to be con-
med by the shape of the two 33 that follow it; from which
the bottom curve towards the right hand (as it was often
ade formerly) was taken off, the upper part would make
e 2. Which agreement between those figures is not only
ual at present, but often found in manuscripts of the four-
enth and fifteenth centuries. Tho' sometimes indeed it is
herways; and the 2 has an angle at the top, when the 3 is
und, which would not so well have suited this square hand.
he reason which occasioned the carrying this date so high
ust he presumes, have been the similitude between the
all *i* over the preceeding abbreviated word *Domini* and
is 2. But tho' they appear to have some likeness, yet
ere is a manifest difference between them: For, the 2 is
uch larger at the top, where it has an angle, and a curve
wnward, that plainly distinguish it from the former. Could
be taken for a 1, he should much rather suppose it was
designed

deſigned for a letter than a figure; and the 2 following cha-racters for a double *ll*; and ſo the whole to be only an abbre-viation of the word *milleſimo*. But as he thinks it muſt be 2, for the reaſons already aſſigned, and as he does not remember to have ever met with ſuch a double *ll*, he cannot but eſteem the other the true reading. And yet ſtill he believes this date may claim the preference of being the oldeſt of the ſort, that has hitherto been diſcover'd.

The antiquity, aſcribed to the *Colcheſter* date, namely 1090, has, it ſeems, been occaſioned by a miſtake in the copy: For the 0 in the place of hundreds ſhould have been made a 4, by drawing down an oblique ſtroke on each ſide from the bottom, which makes it 1490, before which time the 4 had long re-ceiv'd that ſhape, as may be ſeen in Fig. 2. This information Mr. *Ward* had from Mr. *Weſt*, a perſon well ſkilled in the *Britiſh* antiquities, and who himſelf perceiv'd the miſtake in viewing the original.

As to the date from *Widgel-hall*, which gave occaſion to this enquiry, it ſeems to Mr. *Ward* plainly intended to expreſs the year 1000, and no more, by the *Roman* character (Fig. 3.) in the eſcutcheon on the right ſide. For, the characters in the other eſcutcheon cannot, he thinks, ſtand for figures, but muſt be the initial letters of two names J. G. as W. R. in the *Hel-don* date; and were very probably deſigned in both to denote the perſons who erected thoſe buildings. The omiſſion of a character in the place of hundreds is ſtill an argument with him, that theſe two laſt were not made for figures. But what he imagines puts the matter paſt all doubt, is the want of evi-dence that the figure 6 had receiv'd that form till ſome ages after: And when it was introduced, the upper part was not at firſt made ſo erect, as it is here, but carried in a ſmall arch juſt over the top of the circle, as may be ſeen in Fig. 2. On the other hand what looks here like the modern 6 was at that time the uſual form of the capital G. This he found fully con-firmed by a large collection of original grants, made by our an-cient kings and others, and preſerv'd in the *Cottonian* library, *Auguſtus* II. Upon conſulting theſe for half a century at leaſt both before and after the year 1016, Mr. *Ward* found the G written in a great number of them, of which the following are ſome few inſtances. N. 37. *Anno* DCCCCLX. N. 35. *Anno* DCCCCXCIII. N. 53. *Anno* MXLV. N. 49. *Anno* MLXXXI.

For these reasons, therefore, he makes no question, but that
racter was designed for a G and not a *6*. And it is plain
m other circumstances in Mr. *Gulston*'s letter, that the build-
 might very probably be as ancient as the year 1000; which
ders this relique of it, considering how firm and sound it still
 a remarkable curiosity.

The use, Mr. *Ward* thinks may be made of these observa-
ns, is this: That so far as hitherto appears, any coin, in-
iption or manuscript, with a suppos'd date before the thir-
nth century, expressed in *Arabian* figures, may be justly sus-
cted either not to be genuine, or not truly read; unless the
iquity of it be certain from other clear and undoubted cir-
mstances, and the date bear no other reading; and if it be a
py, that it has been taken with exactness.

me Considerations on the Antiquity and Use of the Indian Characters *or* Figures; *by Mr.* John Cope. Phil. Trans. N° 439. p. 131.

THE ingenious invention of figures by the sagacious *Indians* is of such vast importance in numbering, that it
n never be sufficiently admired, tho' now a days the use of
em is become so familiar among us, that very few consider
hat a loss the want of them would be to people of every de-
ee and station in life: For, only to consider, that such a num-
r as not long before the conquest would take up a good arith-
etician whole days to count by the literal characters, is now
 the help of figures commonly express'd by a child in a few
inutes. This consideration of the vast use of figures put the
arned Dr. *Wallis*, and others after him, upon enquiring at
hat time they were first happily introduced into this island.

Dr. *Wallis* informs us, that we had the figures from *Spain*
hither they were brought by the *Moors*; the *Moors* had
em from the *Arabians*; and the *Arabians* from the *Indians*.
nd it was the Dr's opinion, that they were first brought into
ngland about the year 1130: In regard the first instance of
eir use, which he had met with, was a date upon a chimney
iece, which date was 1133 (as represented in Fig. 4.) the cha-
cter, which the *Romans* made use of to express 1000, being
ixed with figures, as he observes, was often done at their first
oming in; since that, in *Phil. Trans.* N° 266 is mention'd a
ate, 1090, all in figures. Mr. *Cope* himself had produced a
ate upon a chimney-piece at *Widgel-hall* in *Hertfordshire*,

 which

which was (as ſhewn Fig. 5.) 1016, the character for the 1000 being here again mixed with figures. And now he produces a ſtill earlier inſtance of the uſe of figures in *England*, as in Fig. 6. which is a draught of an inſcription over a gate-way at *Worceſter*, built, as it is believed, in the reign of king *Edgar*, and is 975, which is 158 years before Dr. *Wallis*'s date; 41 years before that Mr. *Cope* had produced formerly, and is now 760 years ſtanding. The ſhape of the figures in his date were alter'd from what they are here ſhewn to be, about 2 years before, when the gate was new chipped and beautified; and at the ſame time the modern figures 975 were then painted in their room, as they are now to be ſeen; the ground is gold, and the figures black. The account of this date Mr. *Cope* had from Mr. *Joſeph Dougharty* of *Worceſter*, who lived in the houſe over the gate-way on which this inſcription is: He likewiſe informed him, that his houſe goes by the name of *the oldeſt houſe in five counties:* And it is the current opinion thereabouts, and reported by the ancient people in that place, that the houſe was built by king *Edgar*, wherein they ſay - - he ſometimes kept his court. Mr. *Cope* owns himſelf not ſo well acquainted with the hiſtory of thoſe times, as to ſay whether king *Edgar* either built, or kept his court there; but all hiſtorians agree that *Worceſter* was then a very conſiderable Biſhopric; and that *Dunſtan* and *Oſwald*, who were ſucceſſively Biſhops there in *Edgar*'s time, were both his great favourites, eſpecially *Dunſtan:* For, it appears that the firſt thing *Edgar* did after he came to the crown was to recall *Dunſtan* from *Flanders*, where he had been 3 years in exile; and immediately thereupon was made prime Miniſter, favourite and confeſſor, and firſt Biſhop of *Worceſter*, and afterwards Archbiſhop of *Canterbury*; upon which laſt promotion his great friend *Oſwald* ſucceeded him in the ſee of *Worceſter:* And it is very likely that either *Dunſtan* or *Oſwald*, as having ſo much power, intereſt, and riches, might erect a building there, of which this gate-way might have been a part: For, as *Edgar* died in the ſame year 975; if we ſuppoſe the date to be fixed upon the building the year it was finiſh'd, as is now commonly done, *Edgar* could not live or keep his court there, unleſs it was in ſome part of that year, in which we ſuppoſe it to be finiſh'd.

Mr. *Cope* next mentions ſome obſervations upon the different ſhape the figures have been alter'd to, ſince their coming into theſe weſtern parts: For, our anceſtors wrote them different

from

m the *Indians*; and we again make some of them different m what our ancestors did, as will appear by the table repre- nted in Fig. 7.

In this table the left hand column contains the *Indian* cha- cters; the middle those used by our forefathers, as appears by l western manuscripts; the third, the characters we now use.

We may now observe, that the figure 1 is the same as the *dian*; the figures 2 and 3 the same with the *Indian*, only aced in a different position, for the sake of writing them re readily; for, only the dash from the *Indian* 3 is taken ay; they are only, as we may say, both set upright: So *Indian* character for four is much the same with ours; only close the head, and set it upright, thus 4. Again, our an- tors transferr'd the *Indian* character for 5 from the place of to that of 8, and with very little alteration is our 8 made m it. As the figure 5 was mov'd into the place of 8; so the l eight was mov'd into the place of seven: And as they put five for an eight, they put the six into the place of five, ich character for six was at length alter'd as in the figure, l last of all to 5. The 2 characters 9 and 0 are without y alteration, only that our ancestors struck a line cross the cy- er, which we now leave out; and by that means it is restor'd its ancient form. And now we have no figure left but the *dian* character for 7 to derive the modern 6 from, to which it ms to have no manner of relation: Mr. *Cope* only observes, t it seems not unlikely to be compounded of the *Indian* 0 and the 1, as thus, 6: For, of the 2 ancient characters for the 0 is *Indian*, and the other *Arabian*; this last being no er than the *Arabian* letter (represented in Fig. 8.) inverted, ich in the *Arabian* alphabet denotes the same number; and as it is suppos'd, us'd by the *Arabians* only.

The *Roman* characters have likewise undergone alterations: r, it is found that 1000 was represented by the ancients by the aracter (Fig. 9.) as also by the character (Fig. 10.) whence is iv'd the modern M for that number: Also 5000 was repre- ted by the character (Fig. 11.) and 50000 by the character g. 12.) and hence the modern characters IↃↃ and IↃↃↃ for same number. We also find in ancient inscriptions the cha- ters (Fig. 13) stand for 20, and that in Fig. 14 for 30; the ter X being twice express'd in the one, and three times in the er, which the moderns write single, as XX and XXX, y the timber merchants use the ancient characters (as repre- ted in Fig. 13 and 14.) to this day.

Remarks on the aforesaid ancient Date, *over a Gate-way near the Cathedral at* Worcester; *by Mr.* John Ward. Phil. Transf. N° 439. p. 136.

HAVING in a former *Transaction* communicated to the *Royal Society* some remarks on an ancient date, carv'd in wood, that was found at *Widgel-hall* near *Buntingford* in *Hert-fordshire*, with the characters (represented Fig. 3. Plate VI.) 16, which had been read 1016, supposed to be mixed numbers, the character (Fig. 3.) being *Roman*, and the 2 others *Arabian* or *Indian*, as they are indifferently call'd: This led Mr. *Ward* to consider two other dates of the like kind, formerly publish'd in the *Phil. Transf.* one found at *Helmdon* in *Northamptonshire* in mixed characters (Fig. 3.) expressing, as was thought 1133; and the other at *Colchester*, said to denote the year 1090, entirely in *Arabian* figures. But upon searching into the origin of those figures, and the time when they were first brought into these parts of the world, he could meet with no examples of them in any manuscripts, before some copies of *Johannes de Sacro Bosco* (mention'd by Dr. *Wallis*) who died *An.* 1256, which was 123 years after the latest of the 3 dates above-mention'd. As it could not, therefore, but seem very surprising that workmen should have made use of those figures for such common purposes, so long before they appear in the writings of the learned: So upon a closer examination and farther enquiry he found there was no reason from any of these dates to suppose it was really true in fact: For, the *Helmdon* date instead of 1133 (Fig. 3.) should, as he then shew'd, be read 1233; the *Colchester* date 1490, instead of 1090: And that at *Widgel hall* had no *Arabian* figures in it, the characters 1 and 6 not being numbers but the initial letters of two proper names I G, in the usual form of those letters in that age.

But there was read before the society an account of a date at *Worcester* (Fig. 6.) more ancient than any of the three former; in which the unit is a *Roman* numeral, and the other two taken for *Indian* figures. He observ'd above, that such mixtures were sometimes found in ancient numbers; but in what manner they were so used, he did not then explain, but for brevity contented himself with referring to the *Algebra* of Dr. *Willis*, a book so very well known. The Dr. thought it necessary to take notice of this, in order to account for his way of reading the *Helmdon* date, in which the charac- (Fig. 3.) only is a *Roman* numeral: And Mr. *Ward* himself h

d met with a few inſtances of it in Dr. *Mead*'s manuſcript of *ethius*, *De Arith. lib.* 2. as CCC29, and DCC68, where hundreds are numeral letters, and both the decimals and its *Arabian* figures, but it is obſervable, this is not done omiſcouſly, but the largeſt numbers are always letters, and e leſſer ones, figures, as in the *Helmdon* date. And *Mabillon e re diplom. tab. xv.* has obſerv'd, that in a curious manu-ipt copy of *Thomas a Kempis*, written in the 15th century, ne of the pages are ſo number'd : Which method, ſo far as pears, was always attended to, and never in any one inſtance verted. So that this *Worceſter* date, which has a *Roman* meral in the place of units, and the two preceding characters ppoſed to be *Indian* figures, is not only without example, t directly contrary to all other inſtances of ſuch mixed num-rs; which conſideration alone might be a ſufficient ground think, there muſt be ſome miſtake in the reading.

But the middle figure, taken for a ſeven, is as remarkable; hich, turning towards the left hand, forms two obtuſe angles; e above, the other below. This ſhape of the ſeven, he be-ves, was never ſeen before, and ſeems by no means to ſuit at age. In the ſpecimen of the figures, taken from *Jo-nnes de Sacro Boſco* by Dr. *Wallis*, as may be ſeen in Fig. the figure ſeven is made in the form repreſented in (fig. 15.) e the two legs of an iſoſceles triangle. And in *Roger acon*'s Calendar, dated 1292, there is only this variation; at the leg to the left hand is ſomewhat ſhortned, as will like-iſe appear in the Table fig. 2. And this form continued l printing was introduced among us; as is evident from *axton*'s *Polychronicon*, and other books printed about that ne : Nor does Mr. *Ward* find it till more latterly in any her ſhape, except that in Biſhop *Beveridge*'s table of *Indian* gures, *Arith. chron. lib.* 1. *c.* 4. the two legs of our ancient ven are drawn parellel, and arch'd at top (as in fig. 16.) ſtead of meeting in an angle : And *Planudes*, a *Greek* writer, as kept the true *Arabian* form (V) like the *Roman* five, which e *Europeans* inverted, as in fig. 2. The laſt alteration this gure receiv'd among us, was by raiſing the ſhorter leg ho-zontally: But no inſtance of it parallel to this in the *Wor-ſter* date, nor any thing like it, has before appear'd: As ere ſeems therefore no reaſon to ſuppoſe it a ſeven, ſo Mr. *Vard* thinks it was probably deſign'd for the *Roman* numeral, n, which was made in this form, like an X; to which cha-cter in the old ſquare hand, this ſuppoſed ſeven (fig. 17.) would

very

very well agree, by supplying only the two extreme parts to the right hand, as in fig. 18. which may be easily supposed to have been decay'd by length of time.

As there is no reason to take the middle character for a seven, so neither is there any to suppose the first intended for nine, being thus placed before two *Roman* numerals, as Mr. *Ward* takes them both to be: It has indeed some similitude to that figure; but nothing more than what anciently was, and still is, common to the letter (fig. 19.) in that hand, which resembles a double character (fig. 20.) with an oblique stroke turned inwards from the bottom of that to the right hand; so that if the other to the left be taken away, what remains will appear in the form (fig. 21.) like what is here call'd nine: And every one, who has any acquaintance with ancient inscriptions knows that letters frequently perish in this manner, one part before another.

Upon these suppositions the true reading would be MXV. But since the old date is now destroy'd, and modern figures put in its place, this must remain uncertain. And Mr. *Ward* cannot but think the former characters must have been very dark and obscure, for the following reasons.

There is a tower, as he is inform'd, over this gate, of which Dr. *William Thomas*, who lives very near it, has given some account, in a treatise, entitled, *A Survey of the Cathedral Church of Worcester*, p. 7. 'it is commonly call'd King 'John's tower, and said by some to be built by him: But it 'was much more ancient; having in the front of it the statues 'of King *Edgar*, and his two Queens *Ethelfleda* and *Ethel-* '*frida*; and the street, it leads into, in several writings 'call'd *Edgar-street*.' See likewise *Hearne*'s preface to *Hemming*'s *Chartularium*, in the frontispiece of which treatise is a draught of those 3 figures. Could there be any room for its being ever supposed to have been built by King *John*, while this date was plain and clear? Or would the author of the survey have contented himself with only saying, *it was much more ancient*; when he could so easily have given us the year had he been satisfied with the reading. King *Edgar* had been a great benefactor to the Cathedral Church at *Worcester*; and is said to have given it 300 hides of land, vide Dr. *Thomas*'s *account of the Bishops of* Worcester. *Edgar* died in 975, but his Queen *Ethelfrida* survived him several years. And as it is not unusual, in order to perpetuate the memory of public benefactors, to erect statues and other monuments of them, after

y are dead, it might be so in the present case, and the street ive its name (for some time at least) from this building. tho' the precise year of this date cannot now be determined h certainty: It is sufficient to have shewn, that neither order of the characters, their shape, nor the oldest examples *Arabian* or *Indian* figures, any where found, do in the least ntenance the reading given it: But on the contrary, all of n afford the highest probability, that it cannot be ge- ne.

Mr. *Ward* only adds, that Mr. *Gale* and Mr. *West* told him, y thought the two first characters taken for a nine and a n, might probably have been nothing but the character re- sented in Fig. 19. which will bring the date to 1005, ten s nearer the time of *Edgar*. Mr. *Ward*'s only difficulty o that reading is, that the character would then have two que strokes (Fig. 22.) prolonged from the bottom, one in middle, besides the other usual one towards the right hand, ch Mr. *Ward* does not remember ever to have met with: as this inaccuracy might arise from the obscurity of the racter; he leaves it to the curious to judge either way as y please, both sentiments equally supposing the original cha- ers of this date must have been *Roman* numerals.

This enquiry is the more necessary, as it is apprehended to be atter of some consequence, especially with relation to ma- ripts: A copy, for instance, of some ancient author, written 375, and dated in *Arabian* figures, may, by changing only 3 into a cypher, be carried back 300 years; or by making nine, and taking out the 1, may be raised still a century er, to 975, the supposed year of the *Worcester* date: And conversant in manuscripts are sensible that the age of them ot always be determined barely by the hand: Since, there- *Arabian* figures are in most cases much more easily falsified *Roman* numerals, Mr. *Ward* presumes a too great caution ot be used, in admitting any instances of them more , than have hitherto been discovered, but upon very clear sufficient evidence.

eriments on Electricity; by Mr. Gray. Phil. Transf. N° 439. p. 166.

EB. 18. Mr. *Gray* tried what effect would be produced on several sorts of wood, with respect to the luminous part of ricity; the wood (which was fir, ash, and holly) was made rods of the same form with the iron ones mentioned in former

former experiments; these being successively disposed upo electric bodies, in the same manner as the iron rods had been and the tube applied to one end, there appeared a light on i but not with so great a force, nor did it extend to so great length; neither was its form conical, but rather cylindrical; b its extremity seem'd to consist of a short fringe of light; wh the light, communicated to the rod by the application of th tube, ceased, upon a motion of the hand towards the poi of the rod, the light came out again, as was mentioned of th iron rods; but when the hand or finger was held near the poi of these wooden rods, there was no pricking or pushing of th finger felt, as when the iron rods were made use of. Mr. *Gr* had some of these rods made much bigger at one end, than th other, and now applying his finger to the larger end, the not only appeared a light, but the finger was pushed, more esp cially when the holly rod was made use of; and the chee was a little pricked, but the smart was not near so great, when the iron rods were used; the great end of the rod w pointed with a much larger angle than the lesser one; y there was very little, if any difference, in the form or bign of the light that proceeded from either end.

Having procured two pair of lines of worsted yarn, one mazarin blue, the other a scarlet colour, on the 3d of *April* suspended the boy, first on the blue lines, and he found the effects the same, as when he was suspended on lines blue silk: He then suspended him upon the scarlet lines; b now tho' the tube was as well excited, and the experim often repeated, yet there was no effect produced on him, eith of attraction of a pendulous thread, nor of pricking or bur ing, by applying one's hand near him; he then laid one of t iron rods, first upon the blue lines and all the same effects w exhibited, as when the same rod had been laid on silk li of that colour; but upon laying the same rod upon the scar lines, no manner of attraction, *&c.* was perceived.

Mr. *Gray* now found, that when the stand with the little i cups (mentioned in the experiments on the communicative e tricity of water) is set upon any electric body, the same p nomena are produced, not only by holding the tube near water, but when that is removed, and the tip of the fi placed over the water, there is a little hill or protuberanc water of a conical form, from the vertex of which procee a light, and a small snapping.

May 6, the following experiment was made: The boy be-
g ſuſpended on the ſilk lines, and the tube applied near his
et, as uſual: upon his holding the end of his finger near a
entleman's hand, that ſtood on a cake made of ſhell-lac and
lack roſin; and at the ſame time another gentleman ſtanding
the other ſide of the boy with the pendulous thread; the
oy was then bid to hold his finger near the firſt gentleman's
and; upon which it was pricked, and the ſnapping noiſe
eard; and at the ſame time the thread which by its attrac-
on was going towards the boy, fell back, the boy having loſt
great part of his attraction; upon a ſecond moving his fin-
er to the gentleman's hand, the attraction ceaſed; then the
hread being held near that gentleman, he was found to at-
act very ſtrongly: But having afterwards repeated this ex-
eriment, Mr. *Gray* found that tho' the attraction of the boy
much diminiſhed, yet he does not quite loſe it, till 2, 3, and
ometimes 4 applications of his finger to the hand of him, that
ands on the electric body, but without touching him. At
nother time he cauſed three perſons to ſtand, one on a cake
f ſhell-lac, &c. the other upon one of ſulphur, the third on a
ake of bees-wax and roſin; the perſons all holding hands,
nd the boy applying his finger near the firſt man's hand,
hey all three became electrical, as appeared by the attrac-
on of the thread, when held near any of them.

June 10, in the morning Mr. *Gray* repeated the experi-
ents with the wooden rods, the moſt material of which
ere made with the holly rod; and this being laid on the
laſs cylinder, and a fir board, about a foot ſquare and $\frac{3}{10}$ of
n inch thick, placed erect upon a ſtand, which was ſet on
nother glaſs cylinder; ſo that the centre of the board was
laced near the point of the rod, but not to touch it by near
alf an inch; then the tube being held near the great end
f the rod, there iſſued out a light from the little end of the
od, which was that next the board; and as the boy told
Mr. *Gray*, it came along with a hiſſing noiſe, and ſtruck
gainſt the board: When he touch'd the board, there was
light; and at the ſame time, another on the end of the
od, but he heard no ſnapping nor pricking of his finger, as
hen the braſs plate and iron rod were made uſe of.

When the boy was ſuſpended upon the ſcarlet lines, he
ttracted the white thread at a very ſmall diſtance, but the
ttraction ceaſed in about 6 or 7 ſeconds of time: Then
he boy being taken off, an iron rod was laid on the lines;

but there was no attraction of the thread by the body of the rod; but when the thread was held near either of its pointed ends, there was a small repulsion of it, and in the dark a very small light was seen at each end of the rod.

When the boy was suspended upon the blue lines, he attracted the thread to him, when it was held at least a foot distance from him, and continued his attraction to near 75 seconds; the iron rod continued its attraction not more than 36 seconds.

In the afternoon when the boy was suspended on the blue lines, he continued his attraction 50 minutes; on the scarlet lines, 25 minutes; on the orange coloured lines, 21 minutes.

By these experiments we see the efficacy of electricity on bodies suspended upon lines of the same substance, but of different colours, and also that the attraction continues much longer upon silk than yarn; and consequently silk is the properest body to suspend bodies upon, to which we would communicate electricity.

An Account of the Births and Burials, with the number of Inhabitants at Stoke-Damerel, *in the County of* Devon; *by Mr.* William Barlow. Phil. Transf. N° 439. p. 171.

UPON taking a survey about *Michaelmas* 1733, of the inhabitants of *Stoke-damerel*, the number of persons (men, women, and children) residing in the parish, amounted to 3361. By the register Mr. *Barlow* finds, that in the same year, 28 couple were married, 61 males, and 61 females baptized and 62 people buried.

Baptized.	Buried.	Number of people
122.	62.	3361.

Whence it appears, that the number of persons who died, is one more than half the number of children born, and that about 1 in 54 died.

It is to be observ'd, that the general fever, which almost all the inhabitants of the same place were ill of at the same time, was in part within the year mentioned; also that one of the persons included in the number of those buried, was a foreigner brought from on board a *Dutch* ship in the river; and that two more were drowned from on board a man of war; but the ship's company is not included in the number of the inhabitants.

It appears both from experience and observation, that the parish of *Stoke-damerel* is as healthful an air as any in *England*.

The

he foramen ovale of the Heart found open in an Adult; by Mr. Amyand. Phil. Transf. N° 439. p. 172.

MR. —— dying at the age of 22, of an illness that had perplexed his physicians, was opened, to discover an posthume, which was apprehended in the belly: As no-ing was observ'd there worth notice, but a very great re-ation of the *viscera*, the cause of his death was looked for the *thorax*; and there the lungs were strongly attached on ch side, to the *pleura*, and a large collection of water in ch cavity, especially on the left, where the posterior lobe s inflam'd and tending to suppuration: The quantity of ter in the *pericardium* was greater than usual, and the art much larger than could be expected in so great an ophy, as the patient was reduced to; in it the *foramen le* was found open, so as to give passage to a large finger, en a fungous substance, which grew from the circumfe-nce of the foramen, and stopt up the same, was remov'd: e valve was hardly perceptible, being callous and furl'd up: e *ductus arteriosus* was found close as usual. This patient d enjoy'd great health till latterly, and gave no sign of this ening of the *foramen ovale*, which is preter-natural in lts.

Proposition relating to the combination of transparent Lens's *with reflecting planes; by Mr.* Hadley. Phil. Transf. N° 440. p. 185.

THE effects of the combining several kinds of tele-scopes with reflecting planes led Mr. *Hadley* to the lowing proposition.

That if two lens's of equal focal length be put together he form of a telescope, and a plane speculum be placed ore one of them, so that the axis of the telescope make angle with its surface, and a ray of light (the line of ose direction lies in a plane perpendicular to that surface, passing thro' the axis of the telescope) fall on it, and be ected from it, so as to pass thro' the telescope; then the of its last direction, after passing the telescope, will make angle with that of its first direction, before its incidence he speculum, very nearly equal to double the angle, de between the axis of the telescope and the surface of speculum.

Lemma. Let the line F G (fig. 23. pl. VI.) be the commo axis of the two lens's I D and K E, of equal focal lengths to which let the lines A D, D B and B E, be each equal and let a ray of light, issuing from a point in the axis F, fa on the lens I D at I, and be there refracted into the line I G cutting the axis in G, and meeting the lens K E in K; whe let the ray be again refracted into the line K H, cutting th aforesaid axis in H: The angles I F D and K H E ar very nearly equal.

Demonstration. We learn from dioptrics, that the lin F I, I G, K H, and F G are all in the same plane; and b the construction, the lines A D, D B and B E are equal and by *propos*. 20. of *Huygens*'s dioptrics, the lines F A, F and F G are continually proportional; and consequently F is to A D, as F D to D G; and by division, F A is to A as F D — F A (= A D) is to D G — A D (= B G.) Ther fore, A D is to B G, as F D to D G. By the same propos tion, the lines B G, E G and H G are also continually pr portional, and B E (= A D) is to B G, as E H is to E Hence it follows, that the lines F D, D G, and E H, E are proportionals: But as F D is to D G, so is the ta gent of the angle I G D, or K G E to the tangent of th angle I F D; and as E H is to E G, so is the tangent of th angle K G E to the tangent of the angle K H E: The ta gent of the angle K G E, therefore, has the same proporti to the tangents of each of the angles I F D and K H E, a consequently those angles are equal Q. E. D.

N. B. In the demonstration of the above cited propositi of *Huygens*, the thickness of the lens's is neglected, and t distance of the points I and K, from the line F G, su posed very small; so that if either of those are too gre there may arise a sensible difference between the angl I F D and K H E.

Let D F and C G (fig. 24.) represent the two lens's p together as before, having their common axis in the line E and B N a plane speculum, to which that line is inclined the angle G H N, and let A B be a ray of light, falling the speculum at B, as is before expressed, and let it be th reflected towards the point C of the lens C G, where i refracted towards the point D of the lens D F, and th again refracted into the line D E, cutting the axis in The angle A O P contained between this last line D continued backwards, and the first line of the incidenc the ray A B, will be very nearly equal to double the an

inclination of the axis of the lens's EL to the plane of speculum B N; *i. e.* double the angle G H N.

Demonstration. Produce the lines of incidence and re-ction of the ray A B and B C, till they meet the axis of two lens's in I and L; and thro' the point B draw B K rpendicular to the plane of the speculum, and cutting the ne axis in K, the angles K B L and K B I are equal: e angle K L B is the difference of the angles I K B and B L; and the angle H I B is the sum of the angles I K B d K B I (equal to K B L): Therefore, the angle I K B equal to half the sum of the angles H I B and K L B: But the foregoing *lemma*, the angles K L B and F E D are ry nearly equal: Therefore, the angle I K B is nearly ual to half the sum of the angles H I B and F E D: *e.* to half the angle P O B; and its complement B H I G H N is nearly equal to half the angle A O P, the mplement of P O B to a semi-circle. Q. E. D.

If the first incidence of the ray be supposed to be in the e E D, it will proceed in the same track as before, but th the contrary directions; so that the angle E O B made tween the first incident ray, and the last reflected one, ll still be equal to the double of G H N, as before.

It is evident that on this principle an instrument might be nstructed, whose effects would, in a great measure, resem-e those of that in *Phil. Trans.* N° 420: But it would liable to the errors arising both from the spherical figure of e lens's, and the different refrangibility of the rays of ght, when the object is seen at a distance from the axis of e telescope; altho' those errors, by a proper disposition of e parts of the instrument, may be reduced to a very small antity: However, for this reason, and because the in-ument seemed to Mr. *Hadley* to be attended with greater conveniencies, both in its construction and use, than the her, he has not thought it necessary to give a more par-ular description of it.

large bony substance found in the Womb; by Dr. Hody. Phil. Transf. N° 440. p. 189.

N examining the pelvis of a woman, 57 years of age, Dr. *Hody* found a large bony substance in the womb, and so ictly united to it, that they seem'd one and the same body: pon cutting the substance asunder, he observed the ossifica-on went no farther than the thickness of a shilling; the part

part immediately under the offification was like firm flefh, and this flefh grew fofter and fofter, as it drew near its centre.

This woman never had but one child, of which fhe was delivered about 27 years before fhe died: Her chief complaints for fome years, were a fhort cough, great difficulty in breathing, frequent uneafinefs in making water, or in going to ftool, and a conftant weight, or bearing down, upon the parts of generation.

The immediate caufe of her death was, undoubtedly, an *afthma*; for, fhe had only one lobe of the lungs left, that was perfectly found; the reft adhered firmly to the *pleura*, were very much contracted, and in fome places fcirrhous.

A (Fig. 1. Plate VII.) reprefents the bony fubftance; B the fubftance of the womb cut open, and turned backwards; C fmall fibres connecting the bony fubftance with the *uterus*; D the right *Fallopian* tube lying upon the membrane, which joins the tube to the *uterus*, and to the *ovarium*; E the *ovarium*; F the *Morfus diaboli*; G the left *Fallopian* tube cut off; H the neck of the *uterus* cut open, as elongated by the difeafe; I the mouth of the *uterus* laid open; K the greateft part of the *vagina* likewife laid open.

This *uterus*, with the bony fubftance adhering thereto, having been kept 10 years in fpirits before it was fent to the engraver, the *vagina*, *Fallopian* tube, the membrane on which the tube lies and the *ovarium*, muft be fuppofed to be greatly contracted: But that part of the *uterus* diftended by the bony fubftance is indeed very little contracted: For, when firft taken out of the body it was fcarce as thick as a half crown piece.

Some Experiments concerning the impregnation of the Seeds of Plants; *by Mr.* Logan. Phil. Tranf. N° 440. p. 192.

AS the notion of a male feed, or the *farina fœcundans* in vegetables is now very common, Mr. *Logan* only mentions fuch obfervations, as may have fome tendency to the fubject in hand: And firft, he finds from Mr. *Miller*'s dictionary, that M. *Geoffroy*, from the experiments he made on *Maiz*, was of opinion that feeds may grow up to their full fize, and appear perfect to the eye, without being impregnated by the *farina*; which poffibly, for ought Mr. *Logan* knows, may in fome cafes be true, as there is no end of varieties in nature. But in the fubject M. *Geoffroy* mention'd, Mr. *Logan* has reafon to believe it is otherwife; and that he did not apply all the care requifite in the management.

In

n ſpring Mr. *Logan* reſolv'd to make ſome experiments on iz or *Indian* corn. In each corner of his garden (which is foot in breadth, and near 80 foot in length) he planted a hill that corn; and watching the plants when they grew up to a per height, and were puſhing out both the taſſels above, and s below: From one of thoſe hills he cut off the whole taſ-; on others he carefully open'd the ends of the ears; and m ſome of them he cut or pinch'd off all the ſilken fila-nts; from others he took about half, from others one fourth, three fourths, &c. with ſome variety, noting the heads, the quantity taken from each: Other heads again he tied at their ends (juſt before the ſilk was putting out) with fine ſlin, but the fuzzieſt or moſt nappy he could find, to prevent paſſage of the *farina*; but that would obſtruct neither ſun, or rain. He alſo faſten'd it ſo very looſely, as not to give leaſt check to vegetation.

The conſequence of all which was this; that of the 5 or 6 s on the firſt hill, from which he had taken all the taſſels, m whence proceeds the *farina*, there was only one that had much as a ſingle grain in it; and that in about 480 cells had about 20 or 21 grains; the heads or ears, as they ſtood on plant, look'd as well to the eye as any other: They were of r proper length; the cores of their full ſize: But to the ch, for want of the grain, they felt light and yielding. On core, when diveſted of the leaves that cover it, the beds ſeed were in their ranges, with only a dry ſkin on each.

n the ears of the other hills, from which he had taken all ſilk; and in thoſe he had cover'd with muſlin, there was ſo much as one mature grown grain, nor other than what he mention'd in the firſt: But in all the other ears, in which he left part, and taken part of the ſilk, there was in each the t proportion of full grains, according to the quantity or nber of the filaments he had left on them. And for the few ins he found on one head in the firſt hill, he immediately ac-nted thus: That head, or ear, was very large, and ſtood minent from the plant; pointing weſtward with its ſilk di-ly towards the next hill of *Indian* corn; and the *farina*, he ws, when very ripe, on ſhaking the ſtalk, will fly off in the t duſt, ſomewhat like ſmoke. He therefore, with good on, judged that a weſterly wind had wafted ſome few of e particles from the other hill, which had lit on the ſtiles of ear, in a ſituation perfectly well fitted to receive them, ch none of the other ears on the ſame hill had: And indeed

he

he was surprised that he found no more of the same ear impreg-nated in the same manner.

As Mr. *Logan* was very exact in this experiment and curio[us] enough in his observations, he thinks it may reasonably [be] allow'd, that notwithstanding what M. *Geoffroy* may have de-liver'd of his trials on the same plant, that the silk was tak[en] quite away from those heads, and that in such as were cove[red] with muslin none of the grains will grow up to their size, wh[en] prevented from receiving the *farina* to impregnate them; b[ut] appear, when the ears of corn are disclosed, with all the be[ds] of seeds or grains in their ranges, with only a dry skin on eac[h] about the same size as when the little tender ears appear fi[ll'd] with milky juice before it puts out its silk. But the few gra[ins] that were grown on the single ear were as full and as fair as a[ny] he had seen; the places of all the rest had only dry empty p[el-]licles as he has described them; and he much questions, wh[e-]ther the same does not hold generally in the whole course of v[e-]getation, tho' it may not be safe to pronounce absolutely upon without a great variety of experiments on different subjects. B[ut] he believes there are few plants that will afford so fine an opp[or-]tunity for observation as the maiz or *Indian* corn; because stiles may be taken off or left on the ear, in any proportio[n] and the grains be afterwards number'd in the manner men-tion'd.

Some Observations of Eclipses *of* Jupiter's Satellites, *at* Sou[th-]wick, *near* Oundle *in* Northamptonshire; *by Mr.* Ly[nn] Phil. Transf. N° 440. p. 196.

THE telescope Mr. *Lynn* made use of in the follow[ing] observations is the same as formerly, having a 13 [feet] object glass, with an aperture of 2 inches and 4 tenths, and eye-glass of 2 inches and ½ *focus*; by apparent time at *Sou[th-]wick*, near *Oundle* in *Northamptonshire*; longitude west f[rom] *London* 30 minutes as follows.

Year		Mon.	D.	H.	M.
1730	The second satellite began to emerge	*Apr.*	29	10	19
	In a minute after it seemed to be as bright as the 4th satellite				20
	And at full brightness about				21
1729-30	The 4th satellite emerged	*Jan.*	25	9	45

ear		Mon.	D.	H.	M.	S.
730	The second sat. began to immerge	*Nov.*	28	13	17	46
	And was quite out of sight				19	46
31	The second sat. began to emerge	*Mar.*	29	11	33	8
	And seemed at full brightness about				36	30
	The first sat. began to emerge	*Apr.*	18	11	45	10
	And was at full brightness about				46	10
	Again the first began to emerge	*May*	4	10	4	30
	Was at full brightness about				5	45
	And pass'd by the third satellite at			11	49	30
30 1	The first sat. began to immerge	*Jan.*	7	12	2	55
	And was quite out of sight about				4	25
31-2	The third sat. began to immerge	*Jan.*	28	14	16	00
	Was but equal in light to the second at				19	00
	Quite disappear'd at				24	00
32	The second sat. began to emerge	*Apr.*	30	12	23	57
	The first sat. began to emerge	*May*	6	12	48	44
32-3	The third sat. quite disappear'd	*Feb.*	18	13	5	30
33	Again the third sat. disappear'd	*Apr.*	2	13	3	30
	But it began to fail of its light about 5 or 6 minutes before					
35	The second satellite immerged	*May*	28	10	45	00
	The third began to emerge	*Aug.*	3	9	10	30
	And was 4 or 5 minutes before it came to its full brightness.					

cerning the High Tide *in the River of* Thames *on* Feb. 16, 1735 6; *by Mr.* Jones. Phil. Transf. N° 440. p. 198.

MR. *Jones* having in a former *Transaction* given an account of the tides flowing in the river of *Thames*, which n flow'd 20 foot 5 inches and a half, as he took it by a le- from that high water mark to low water the next morning, l was 4 inches higher than had been known for 40 years be- e: He now adds, that having marked that high tide on a t; on the 16. of *February*, 1735 6 the tide rose at the same ce 6 inches ¾ above that mark, and flow'd near 2 foot the half hour but one before high water.

Had the tide flow'd its full time, it would have flow'd half an r longer, and drowned the whole level.

A singular cutaneous Distemper; *by Dr.* Abraham Vater. Phil. Trans. N° 440. p. 199. *Translated from the* Latin.

IN *Phil. Trans.* N° 424 is an account of a very extraordinary and curious case of a distempered *cutis* or rather *cuticula* in a country lad of 14 years of age; it was so thick and hard as to be rather like the bark of a tree than a human skin; and like a case it covered his whole body; excepting the palms of the hands and soles of the feet, that he seemed to be enveloped in it; it was yearly shed in autumn.

This case is very well illustrated by the history of a girl of 8 years of age, at *Gera* in *Voigtland*, a seat of the counts of *Reussen*, as the Dr. had it from Dr. *Harnischius*.

For some years before, she had laboured under a swelling of her joints and whole body; and after the use of several quack and other medicines, a remarkable hard tumour arose on her back between the shoulder-blades, which being taken for a beginning bunch, it was discussed by topical applications. But from that time there insensibly began to grow on her hands and feet, especially on the palms and soles, a dry hard crust, that projected a good way on the ends of the fingers and toes, and hindered her grasping and walking, so that she could neither stand nor go, but was fain to be carried. At times the crust sheds, especially after various inunctions; but thereby she became ill, and swoln, with anxiety and pains internally, that continued till the crust was again renewed: Upon which she felt no other inconveniency then being depriv'd of the use of her hands and feet. In a year after, upon the disorder recurring she was committed to the care of a surgeon, who with mercurial laxatives and cleansing decoctions removed the disease, and restored her skin to its former cleanness: So that she seemed to enjoy a perfect state of health; but whether it should continue time must shew. Upon viewing this crust with a microscope, it plainly appears to consist of little scales, which the more evidently shews, that it is nothing other than the cuticle itself expanded and harden'd by a viscid and tartarous nutriment. The same Dr. *Harnischius* also relates that in a neighbouring town there is a young woman, who twice a year for a long time shed such a crust from her hands and feet as also from the arms, and found no relief from any medicines hitherto made use of. But this latter patient laboured under an obstruction of the *Menses*, which seemed to be the source of this disorder.

Ex

Experiments concerning the Vibrations of Pendulums; by Dr. Derham. Phil. Transf. N° 440. p. 201.

THE account Mr. *Bradley* gave in *Phil. Tranf.* N° 432, of obfervations made at *Jamaica* by Mr. *Campbell*, with a nice pendulum clock of Mr. *Graham*'s making, brought to Dr. *Derham*'s mind fome experiments he made fome years before, that may be of ufe in obfervations of this nature.

The firft he takes notice of are fome experiments he made in 1704, with excellent inftruments, concerning the vibrations of pendulums in *vacuo*, that were publifhed in *Phil. Tranf.* N° 294: The fum of which is that the vibrations in *vacuo* were larger than in the open air, or unexhaufted receiver; as alfo, that the enlargement or diminution of the vibrations, was conftantly in proportion to the quantity of air, (or the rarity or denfity thereof,) which was left in the receiver of the air-pump. And as the vibrations were larger or fhorter, fo the times were augmented or diminifhed accordingly, *viz.* two feconds in an hour flower, when the vibrations were largeft, and lefs and lefs, as the air was re-admitted, and the vibrations fhortned.

But notwithftanding the times were flower, as the vibrations were larger, yet he had reafon to conclude, that the pendulum really mov'd quicker in vacuo, than in the air; becaufe the fame difference or enlargement of the vibrations (as two tenths of an inch on a fide) would caufe the movement inftead of two feconds in an hour, to go fix or feven feconds flower in the fame time, as he found by nice experiments.

The next experiments the Dr. mentions, he made at feveral times, *viz.* in 1705, 1706, and 1712, by the help of a good month-piece that fwings feconds: The weight that then drove it was about 12 or 13 pounds, and it kept time exactly by the fun's mean motion: But by hanging on fix pounds more, the vibrations were enlarged; but yet the clock gain'd 13 or 14 feconds in a day.

And as the increafe or diminution of the power that drives the clock, accelerates or retards its motion; fo, no doubt, doth cleannefs or foulnefs affect it; and fo doth heat and cold: For, all have the fame effect upon the pallets and pendulum.

The laft experiments the Doctor mentions, he made in 1716, and 1718, to try what effects heat and cold had upon

iron rods of the ſame length, or as near as poſſible to thoſe that ſwing ſeconds. He made his experiments with round rods of about a quarter of an inch in diameter, and with ſquare rods, about $\frac{3}{4}$ of an inch ſquare; the effects on both which were the ſame.

At firſt he took the exact length of the rods in their natural temper: Then he heated them from end to end in a ſmith's fire, nearly to a flaming heat; by which means they were lengthened two tenths of an inch. Then he quench'd them in cold water, which made them $\frac{1}{150}$ of an inch ſhorter than in their natural ſtate.

Then he warmed them, as near as he could gueſs, to the temper of his body, by which means they were about $\frac{1}{100}$ of an inch longer than in their natural temper.

Afterwards he cool'd them in a ſtrong frigorific mixture of common ſalt and ſnow, which ſhortened them $\frac{3}{100}$ parts of an inch.

Afterwards he meaſur'd theſe rods, when heated in an hot ſun, which lengthen'd them $\frac{2}{100}$ parts of an inch more than their natural temper.

All theſe experiments ſeem to concur in reſolving the phenomenon of pendulum clocks going ſlower under the equator, than in the latitudes from it: But yet he owns, that he has too good an opinion of Sir *Iſaac Newton*'s notion of the ſpheroidal figure of the earth, to part eaſily with it; and therefore he leaves it to the conſideration of others, how far the figure of the earth, and how far heat and cold, and the rarity and denſity of the air, are concerned in that phenomenon.

The Conſtruction and uſe of ſpherical Maps, or ſuch as are delineated upon Portions of a ſpherical Surface; by Mr. John Colſon. Phil. Tranſ. N° 440. p. 204.

GEographical maps and hydrographical charts, tho' repreſentations of a convex ſperical ſurface; yet at firſt were delineated upon planes, as being the moſt eaſy and obvious, tho' not the moſt natural and accurate repreſentations: And they will be ſufficiently near the truth, when the part of the earth or ſeas to be deſcribed is not of a very large extent; and ſuch have been uſually call'd chorographical and topographical maps: But when the map is any thing general, or is to contain any large tract of the earth or ſeas, ſuppoſe, for inſtance, one of the four quarters of the world,

as

s they are call'd; in that case, when the projection or repre-ntation is upon a plane, the parts must necessarily be di-orted; as one way contracted beyond the truth, and another ay dilated: so as to give no just idea of the whole. Nor n this distortion be possibly avoided, when any considerable art of a spherical surface, by any projection whatever, is to e represented upon a plane. It is true, this distortion is lways regular and according to certain laws: So that nowing the nature of the projection, it may tolerably well e allow'd for: But to do this scientifically, and as it ught to be done, requires much skill and accuracy in the aker, as well as good proficiency and experience in the eruser; and therefore not so proper for an introduction to earners in the rudiments of geography; young minds being pt to receive wrong notions and prejudices from them; at east they cannot be rightly and easily instructed by them.

To obviate this inconvenience, geographers have contrived nd constructed the terrestrial globe, on which they endea-our to delineate all the parts of the earth's surface in their atural state, as to longitude, latitude, distance, bearing, mag-itude, *&c.* which being a true and genuine representation f the whole superficies of the earth, as far as it is hitherto nown, is the best adapted for conveying just notions to young inds, and for preventing all false conceptions and prepossef-ons. After the first rudiments of geography have been im-ibed from hence, they will then be prepared for the use of lain maps; and will afterwards find, that large projections f particular countries, kingdoms and provinces *in plano*, ill be of excellent service to them for their farther improve-ent in this useful and necessary science. Nor will they now e in any danger of being misled by such maps, tho' they re not such just and natural representations of the terrestrial lobe.

Now the same conveniencies, that may be derived from e whole globe, may, in proportion, be had from any notable ortions of it; as an hemisphere, a quadrant, a sextant, an ctant, or other part; but with this advantage besides, that ese partial spherical maps will not only be much less cum-ersome, and more managable than a whole globe, but may e made much more accurate and particular, as being ca-able of being formed to a much larger diameter than a lobe can be conveniently made to. The maps may be first rinted on a plane, as is usual in the common globes, and then

then pasted upon thin convex shells of pastboard formed t the intended radius. The forming of these spherical coat of pastboard will be matter of no great difficulty, even to a large a diameter as shall be desired; but the chief art will b required in projecting the maps *in plano*, after the simples and exactest manner; so as that they may adapt themselve with as little error as possible, to a spherical surface: For, plane surface cannot be converted into a spherical surfac without some error. The best method of doing this, wit the least possible error, Mr. *Colson* thinks will be as follows

Instead of the usual slips or gussets, as is the manner o globe-makers, comprehended between two meridians at som distance, and formed only tentatively and mechanically, with out the help of any just theory, we may divide the whol spherical surface into parallel portions, or zones; that is, int parts terminated by two parallels to the equator, at the di stance suppose of 10 degrees. As if the first of these po tions, or zones, were at the equator itself, and extended t five degrees of latitude on each side of that circle, the 2 zone would be at the parallel of 10 degrees of latitude, an would extend to five degrees of latitude on one side, and 15 dregrees of latitude on the other side of that parallel and so of the succeeding zones.

Now we may conceive the first of these portions, or zone to be converted from a spherical to a plane surface in th following manner, without sensible error. Let the midd line of this zone, that is, the equator, continue in its situ tion, and let the segments of the meridians on each side b conceived to unbend themselves gradually, till they are e tended into right lines perpendicular to the equator: Th will that, which was before a zone, or portion of a spheric surface, with a small alteration, become a portion of a cyli drical surface, circumscribed about the sphere; who breadth is every where equal to 10 degrees of the spher and whose circumference is equal to the equator: A thus every parallel to the equator, as far as that of five d grees of latitude on each side will be stretched and extend into a circle, as large as the equator; but they will keep the same distance from one another, and from the equ tor, that they had before. This extension, or alteration, w be every where regular and uniform, and will be but ve little, even where it is most: For, the least of these circ which is the parallel of five degrees of latitude, has

sa

me proportion to the circle it is stretched to, or the equator, as the sine of 85 degrees has to the radius, or as 9961947 to 10000000, which approaches very near to a ratio of equality: And now it will be easily conceiv'd, that without undergoing any other alteration, or distortion, this portion of a cylindrical surface may be rectified, or extended into a plane parallelogram, whose length will be equal to that of the equator, and whose breadth will be equal to an arch of 10 degrees of the same equator.

And consequently, by an operation that will be just the reverse of this; if upon a plane we delineate such a parallelogram as this, we may then lay down all the places contained therein, very exactly, in their proper situation of longitude and latitude; and then apply its middle line or equator to that of a globe of a due magnitude, which will then become a portion of a cylindrical surface, circumscribed about the globe. Then by pressing it close to the body of the globe; we shall cause it to contract itself a very little, but regularly; which contraction will be only according to longitude, and not at all according to latitude: And then the cylindrical surface will be changed into that of a sphere, and become the first spherical zone before described, with all its delineations in their due position, without sensible error.

In like manner in the second spherical portion or zone, comprehended between the parallels of 5 and 15 degrees, whose middle line is the parallel of 10 degrees, we may conceive the segments of the meridians to unbend gradually on each side, and extend themselves into tangent right lines, which therefore will form a segment of a conical surface, still touching the globe in the parallel of 10 degrees of latitude. The axis of this cone will coincide with the prolonged axis of the globe; and the side of the cone, which is to be estimated from the vertex to the circle of contact, will be the co-tangent of the latitude, or the tangent of 80 degrees. Now this portion of a conical surface may easily be conceived to be unroll'd, or expanded into a plane surface, without undergoing any other alteration; and then it will become a portion of a sector of a circle; which portion will have for its length or middle line an arch of a circle, described with the aforesaid tangent, as a radius; whose length will be the same as the parallel of contact, and its breadth equal to an arch of the equator of 10 degrees, as before. This segment of a sector of a circle, so produced, may, there-

therefore, be easily described *in plano*, and within it may be inserted all the places belonging to it, according to their longitude and latitude: Then it must be applied to the globe; so as that its middle line shall coincide with the parallel of 10 degrees. Then by pressing, it may be bent to the surface of the globe, every meridian to its respective representative, by which it will uniformly contract a little according to longitude, but not at all according to latitude. And thus the globe will be cover'd as far as 15 degrees of latitude.

The next zone, or that belonging to the parallel of 20 degrees, may be constructed *à priori* in the following manner: Upon a plain paper, with radius equal to the tangent of 70 degrees, describe an arch, whose length is equal to that of the parallel of 20 degrees; as also two other concentric arches on each side, at a distance from the middle arch, equal to an arch of 5 degrees: This will be the requir'd segment of the circular sector, in which are to be inserted all the places belonging to it, according to their longitude and latitude. Then the middle line or arch is to be applied to the parallel of 20 degrees upon the globe, and the segment of the conical surface, thence arising, is to be duly contracted as before, or press'd close to the globe; by which means this zone will also be compleated. And in the same manner we are to proceed to the succeeding zones, till the whole globe is cover'd: And the method will not differ in any material circumstance, if instead of a whole globe, we are to construct any part of it only, or what Mr. *Colson* here calls a spherical map.

To reduce this theory to practice, and as a specimen of spherical maps, Mr. *Colson* has constructed a terrestrial hemisphere to a diameter of near 15 inches; to which he has given the name of the *British* hemisphere; because it has *Great Britain* in the centre, or rather at its vertex. It is, therefore, adapted to the meridian and horizon of *London*, and exhibits one half of the earth's surface, as it lies round about this City; which is vastly the most considerable part of the whole earth's superficies. The longitude and latitude of places are here easily known by inspection, and their bearing and distances may be nearly estimated: And all the delineations are as accurate and particular as this small radius would permit: He, therefore, conceives it may be no unfit instrument for instructing beginners, or for initiating young minds in the first rudiments of geography.

Copy of an ancient Chirograph, *or conveyance of Part of a* Sepulchre, *cut in Marble, lately brought from* Rome, *together with some Observations thereon, by Mr.* Gale. Phil. Transf. N° 441. p. 211.

The inscription at full length is as follows;

Diis Manibus
Marci Herennij
Proti, vixit annos viginti duos
Menses duos, dies quinque, fecerunt Parentes
Marcus Herennius Agricola &
Herennia Lacena filio.
Chirographum. Ollaria numero quatuor
Cineraria quinquaginta tria intrantibus par-
te lævâ quæ sunt in monumento
Titi Flavii Artemidori, quod est viâ
Salariâ in agro Volusi Basilides
Ientibus ab urbe parte sinistra, Do-
nationis causa Mancipio accepit
Marcus Herennius Agricola de Tito Flavio
Artemidoro Sestertio nummo uno Libripende Marco
Herennio Justo, Antestatus est Tiberium
Julium Erotem: Inque vacuam
Possessionem earum ollarum
Et cinerariorum Titus Flavius Arte-
midorus Herennio Agricolæ ire
Aut mittere, ossaque inferre per-
misit, sacrumque quotiens face-
re vellit Herennius Agricola
Heredesve ejus permisit, Clavisve
Ejus monumenti potestatem factu-
rum se dixit, dolumque malum
Huic rei abesse afuturumque
Se hæc recte dari, fieri præstari-
que stipulatus est Marcus Herennius
Agricola, spepondit Titus Flavius
Artemidorus Actum XVIII. Kalendas Januarii
Caio Calpurnio Flacco, Lucio Trebio
Germano Cos.

This marble, lately arriv'd from *Rome*, and now reposited in Sir *Hans Sloane's Musæum*, is a very valuable piece of antiquity, as it exhibits a complete *formula* of a chirograph, or conveyance of one part of a burying-place from one family to another, but neither of them of any note, seeming by their *agnomina* to have been only *Liberti*, or descended from such. *Agricola*, it is true, is a *Roman* name, but those of his wife *Lacena*, and his son *Protus*, are both *Greek*.

By this chirograph (line 7, 8, *&c.*) *Herennius Agricola* obtains from *Titus Flavius Artemidorus* a right to 4 *ollaria*; which were niches or repositories, wherein they placed *cineraria*, urns or vessels of stone or earth, containing the ashes of the dead; and were here 53 in number.

Fabretti, it is true, in *Inscript. ant. in ædibus pat. p.* 16, 17, takes the *cineraria* to have been niches for receiving and keeping *stone-urns*; but *Gutherius de jure Manium lib.* 2. *cap.* 24, tells us, that *ossuariæ ollæ à cinerariis in eo differunt, quod hæ cineres, illæ ossa exciperent*. Besides, if they were niches, or the same as *ollaria*, the mentioning of them as in this inscription, would be an unintelligible tautology; and *Spon*, in his *Miscellan. Antiq. Erudit. p.* 290, gives us the following inscription, which seems to put the matter out of dispute.

Romæ in operculo Vasis.

CINERARIUM
GEMELL. III AELI
MARCI ET PHILIPPI.

From both which authorities it is evident, that the *cineraria* were vessels and not repositories for them.

This monument was situated on the left side of the *via Salaria*, which ran to the north-west of *Rome* from the *Porta Collina*. It stood in the ground of *Volusius Basilides*; and the consideration for the conveyance of it, is one sesterce. It is very usual in sepulchral inscriptions to find the monument of one family in the field of another; the proprietor of the monument reserving the right of that to himself when he sold the ground; or purchasing so much ground from the owner as was sufficient for erecting the monument. All sepulchres, when once a body was interr'd therein, were esteem'd as religious and sacred, and were not to follow the possession of the field.

Mille

Mille pedes in fronte, trecentos cippus in agrum
Hic dabat, hæredes monumentum ne sequeretur.
Hor. I. Sat. 8.

Line 11. *Basilides* is a blunder for *Basilidis* in the genitive case.

Line 11, 12. The words *donationis causa mancipio accepit M. Herennius Agricola de Tito Flavio Artemidoro* II SN. I. are to be read *sestertio nummo uno*, as is evidently demonstrated from the following inscription, where you have also the rest of the words of this form of conveyance. There is likewise in *Gruter* p. DCCCCLVI. 4. an inscription wherein the words *sestertio nummo uno* are express'd at length.

HOC. MONVMENTUM. SIVE
SEPVLCHRUM. CUM AREA. SVA
T. FVFICIUS FELIX. DE
JVLIA RVFINA. DONATIONIS.

CAVSA MANCIPIO ACCEPIT
IIS. N. UNO. QUOD COMPARAVIT
FVFICIÆ AMPHATÆ
CONJVGI CARISSIMÆ, &c.

They were *verba solennia donationis vel alienationis causâ quæ fiebat per mancipium.* This mancipation was often a fictitious sale of a thing to make the donation of it valid, as in this case. And the mention of one sesterce given for it, is only *dicis gratiâ*, much like our form in leases, *in consideration of 5 shillings in hand paid.* Frequent examples occur of this practice, as in the inscription just now quoted from *Fabretti, inscript. ant. in æd. pat. p.* 50. and others in the same author; and in *Gruter* (p. DCCCCLVI. 4. and MLXXXI.) which latter is a compleat *formula* of a like sepulchral conveyance as this, but of a later date, and not so well preserv'd; it being executed when the Emperor *Trebonianus Gallus*, and his son *Volusianus*, were Consuls *A. D.* 252; and this in Sir *Hans Sloane*'s possession, probably (as shall be shewn farther on) during the reign of *Septimius Severus.*

Line 15. LIBRJ PENDE is cut in the marble as 2 distinct words, as here represented; tho' in reality it should be

 but

but one; and ſignifies the perſon that weigh'd or counted over the money to the ſeller: It ſhould be read LIBRIPENDE, than whom there could not be a more proper witneſs to the pur-chaſe. At the beginning of the *Roman* ſtate their money was uncoined, and call'd *æs rude*, or *grave*, therefore, paid by weight; whence comes the word *libripens*. Under *Servius Tullius*, their ſixth king, it began to be coined, and paid by tale; but the perſon who counted it over to the receiver ſtill re-tain'd his primitive appellation. Almoſt every conſiderable town had its *libripendes*, perſons of ſkill in money affairs, to determine controverſies about the value of it.

An inſcription in *Gruter* (p. MCXV.I.) is a ſtrong proof of this: It was found at *Nola* in *Campania*, and ſhews they had 2 *libripendes* there appointed by publick authority.

T. VEDIVS. T. F.
T. VITORIUS. CN. F.
II. VIRI
LIBRIPENDES
EX. DD.

They had this name; *quia libram æneam tenebant, qui nummos penderent.*

—— *Librâ mercatus & ære.* Hor. Epiſt. II. 2.

And hence we have the words *ſtipendium*, *diſpendium*, *ex-penſæ*, and the like. In *Apuleius's Metamorph.* Book X. the following paſſage; — *ſed ne fortè aliquis, inquam, iſtorum quos offers aureorum, nequam vel adulter reperiatur, in hoc ipſo ſacculo conditos eos annulo tuo prænota, donec altero di* Nummulario *præſente comprobentur*; where this *Nummularius* ſeems to be the ſame as the *libripens*, who was generally call'd in to count over and examine the money at payments for pur-chaſes, tho' ſometimes a private perſon or friend to the parties might probably perform this office for them, and be an evidence upon occaſion, to the facts: To which end alſo they us'd to bring another witneſs, as *Herennius Agricola* does here, who was one *Tiberius Julius Erotes*, and ſometimes they added more. The form and manner of doing it was by aſking a by ſtander, *licetne anteſtari?* If he conſented, the demandant touch'd, or pull'd, the lower part of his ear, as a *memorandum* of what paſſed: Whence *Horace* in his IXth *Sat.*

—— *ca*

——— *casu venit obvius illi*
Adversarius, & quo tu turpissime? magnâ
Exclamat voce, & licet antestari? *Ego vero*
Appono auriculam.

By the law of the XII tables, if he that was call'd to testify this manner, or the *libripens* refused afterwards to give his dence in the case, they were adjudged infamous. *A. Gell.* XV. *c.* 14.

Line 18, *Earum Ollarum* seems to be a mistake for *eorum ariorum.*

Line 20 to 27, are covenants usual upon this occasion, as y be seen in the like sepulchral contracts, particularly, the fore mentioned in *Gruter* (p. MLXXXI.I.) and many other nations and orders about monuments in his voluminous collecn; as also in *Fabretti* and *Reinesius.*

Line 28, S E seems to have been a blunder of the *marmoraus* for SIBI, *se dari* being entirely ungrammatical. But in contract aforesaid, given us by *Gruter*, the words run *de re dolum malum abesse, afuturumque a te, hærede tuo, & his omnibus ad quos ea res pertinebit, hæc sic rectè dari, ri, præstarique stipulatus est*; which inclines Mr. *Gale* raer to believe, that *se* in the present case ought likewise to ve been *sic*. There are several palpable mistakes in it, as in e 23, *vellit* for *velit*, and in line 24, *clavisve* for *clavisque.* The *Roman* lawyers tell us, that *stipulatio* was *interrogatio ntis, solennibusque verbis concepta*; *& apta consentaneaque reonsio, veluti* spondes? spondeo. Dabis? Do. This is fully conmed both in this and the Gruterian contract (p. MLXXXI.I.) the former *stipulatus est Marcus Herennius Agricola: epondit T. Flavius Artemidorus*: In the latter, *stipulatus est icinius Timotheus: spepondit Statia Irene.* The learn'd r. *Mattaire* observes from *Aulus Gellius*, lib. VII. c. 9. that ncient authors used *e* instead of *o*, in those verbs which have a duplication in the preterite tense, as *memordi, peposci, spendi*, for *momordi, poposci, spopondi*, us'd by more modern riters: So that *spepondit* is no mistake, but an archaismus, may the word *ientibus* in the 12th line; tho' it has not been marked, as the latter was. *Iens* in the nominative case was 'd more than once by *Cicero*; and tho' he declines it, as all her authors now in being, *euntis, eunti, &c.* yet it might iginally have been declined *ientis, ienti*: But as there is now

no

no authority extant to warrant it, this must pass as mere conjecture.

Line 32, there are no such names to be found in any of the *fasti Consulares*, as *C. Calpurnius Flaccus*, and *Lucius Trebius Germanus*: So that they must have been, not the *Consules ordinarii* of the year, but the *Suffecti*. It is very strange that the *Romans* should so long adhere to this troublesome and uncertain method of computation by the years of their Consuls; since they had frequently several pairs of them in the same year, especially after the Government became imperial: Some reckon'd by the ordinary Consuls, who came into their office upon the 1st of *January*, about 600 years after the building of *Rome*: For, till that time the month of their entring upon that dignity was not fixed; and others computed by the *Suffecti*, who might come in several months after, as vacancies happen'd, or as they were appointed by the emperor; tho' their names were seldom inserted in the *fasti*. Besides this, it was impossible for any man to remember how many years were elapsed from the present time upwards, to such and such Consuls, without tables of their succession, or having recourse to some other *æra*, as the A. V. C. *anno urbis conditæ*, which they do not seem to have much regarded.

In *Gruter* (p. XLVI. 9.) there is a long inscription, mentioning *Trebius Germanus* (tho' not as Consul) in the reign of *Septimius Severus*; and another (p. CCCLXXXII. 7.) of *C. Calpurnius Flaccus*: If these men were the Consuls here referr'd to, as they might be, the age of the marble in Sir *Hans Sloane*'s possession will be ascertained within a few years.

The stone is turned with an arch a top; the whole length of it is 27 inches and $\frac{1}{2}$; the breadth at the bottom 10 inches and $\frac{1}{2}$; and at the base of the arch 12 inches and $\frac{1}{4}$, it widening gradually upwards. The letters are cut in a small indifferent character; that of the E and the F are remarkable, being always formed in this manner E *f*. It was probably placed over or between the 4 niches, or *ollaria*, granted to M. *Herennius Agricola* in this monument by *T. Flavius Artemidorus*, in order to declare and assert the right and possession of them to the former and his family, till they were all filled.

the Revolutions, which small pendulous Bodies will, by electricity, make round larger ones from West to East, as the Planets do round the Sun; by Mr. Stephen Gray. Phil. Transf. N° 441. p. 220.

MR. *GRAY* made several new experiments upon the projectile and pendulous motion of small bodies by ectricity, whereby small bodies may be made to move bout larger ones, either in circles or ellipses, that are either ncentrical or excentrical to the center of the larger bodies, bout which they move; so as to make many revolutions bout them; and this motion will be constantly the same ay that the planets move about the sun, *viz.* from the right the left, or from west to east: But these little planets, if ey may be so call'd, move much faster in the *apogean*, an in the *perigean* parts of their orbits; which is directly ntrary to the motion of the planets about the sun.

he Construction of a Quicksilver Thermometer, as also Observations on the Eclipses of Jupiter's *Satellites, made at* Petersburgh, An. 1731, 1732; *by* M. Jos. Nic. De l'Isle. Phil. Transf. N° 441. p. 221.

M. *De l'Isle*, in order to have surer grounds for his experiments in natural philosophy in *Russia*, and to compare them with those of other countries, applied himself in inter 1733 to the construction of mercurial thermometers, gulated by the expansion of that fluid proportionably to bulk: This expansion is, it is true, not very perceptible, nsidering that Dr. *Halley* in his experiments made upon it wards of 40 years before (as related in *Phil. Transf.* ° 197.) found that the said expansion, by the heat of boiling ater, was no more than $\frac{1}{74}$ part of the bulk of mercury, e experiment having been tried in the months of *February* d *March*, when the weather was cold enough, tho' it did t freeze.

M. *Amontons* likewise relates in the *Memoirs* of the *Royal ademy* for 1704, that this expansion of the mercury is t $\frac{1}{115}$ part of its bulk from the greatest heat to the greatest ld felt at *Paris*. But M. *De l'Isle* found in the great cold y had at *Petersburgh* on the $\frac{16}{27}$ of *January* 1732-3. in the orning, that the bulk of the mercury was condensed almost part of the extent it had in boiling water. The cold they had

had that day, the wind being at east, was one of the severe that ever was felt there.

M. De l'Isle had his new thermometers made of a goo large size, and in such manner, that having divided in eac the whole quantity of mercury it contains, into one hu dred thousand parts; and having marked the extent the bulk of that mercury in boiling, he can at any time on the divisions of these thermometers, by how many pa the bulk of the mercury is condensed thro' the present te perature of the air. And tho' he had made four of the thermometers, which differ very much as to size, and th quantity of mercury they contain, yet they agree within very few of these parts. As pure mercury is of the sa nature every where, and not liable to any alteration from b ing inclosed in a tube; and as it is probable, that taking equally purified, it will in different countries be subject the same expansion, if exposed to the same degree of hea For this reason he is pursuaded, these thermometers m very well serve to compare the temperature of differe countries; the rather, as he found by experience, th these thermometers may be rendered fit enough to mark sen bly the increase or diminution of the bulk of the mercur within one or two parts out of the 100,000 contained in th whole bulk. This sort of thermometers has also this adva tage, that as they mark the proper expansion of the me cury in each temperature of air, they may serve to she every moment the correction, to be made in the height of t mercury in simple barometers; which will serve for reduci them to the height they would have in an equal tempe ture of air: And one might, for this end, chuse and ag upon the heat of boiling water, as a fixed term, which in appearance will be the same all over the world. If t *Royal Society* should approve of this new construction thermometers, and order some of their members to make t like, we might hereafter be able exactly to compare the te perature of *England* with that of *Russia*, and other pla where the like thermometers should be made.

M. De l'Isle having in 1724 receiv'd of Dr. *Halley* a co of his astronomical tables among which are those of four satellites of *Jupiter* by Mr. *Bradley*, he judged th could not be any better, till some method shall be found explained geometrically to deduce from the laws of grav the effects of the mutual attraction of these satellites on

other, and with relation to *Jupiter*: But as he could not pe this would be done so soon, he took the pains again to culate new tables upon those of Mr. *Bradley*, by reducing tables of the four satellites into the same form with those . *Pound* has made of the first satellite only. These tables ing thus made easy, he has hitherto used them for comparag observations; and his brother has taken the pains, ce the drawing up those tables, in the said manner, to callate a year beforehand, all the eclipses of the four salites. M. *De l'Isle* commonly sent those calculations to his respondents to prepare them for observations, and some ars of those ephemerides have been published in the le Gazette of *Literature of Leipsick*, published in *High utch*. His brother prolonged those calculations to the onth of *January* 1737.

re follow the observations on *Jupiter*'s satellites, which were made at *Petersburgh*.

N. St.	true time.			
31 *Dec.* 6.	17^h	3'	5"	The immersion of the first satellite difficultly observ'd with a reflecting telescope of five foot: The true time was found only by means of two clocks.
32 *Jan.* 4.	13	30	56	Immersion of the 2d satellite by the reflecter, doubtful to a few seconds: *Jupiter* not being well defined, nor sufficiently high. The true time adjusted by two clocks.
9.	18	33	7	Immersion of the 4th satellite by the reflecter: The sky not very serene; and the true time adjusted only by two clocks.
32 *Jan.* 9.	20	25	0	The other satellites disappearing by the day-light, the fourth was not yet emerged out of the shadow; the telescope the same.
Feb. 22.	13	25	34	The first satellite, just entering the shadow, was still visible, when a mist cover'd *Jupiter*.
	13	26	34	*Jupiter* being uncover'd, the first satellite did not now appear

 through

N. St. true time.				
				through the reflecting telescop The true time was adjusted o ly by two clocks.
1732 *Mar.* 8.	8^h	22	20″	Immersion of the 3d satelli by the reflecting telescope: T wind was somewhat troubl some; the true time was adju ed by two clocks.
April 3.	8	46	23	Emersion of the 1st satelli by the reflecting telescope doubtful to a few seconds, reason of the satellite's nearn to the planet.
13.	7	20	30	Immediately after sun-set, *J piter* becoming visible to the e the 3d satellite appeared to out of the shadow, and entir clear by the reflecting telescop
20.	11	6	52	Emersion of the 3d satell by the reflecting telescope. T sky serene.
27.	15	13	0	The 3d satellite had proba been come out of the shadow several minutes: For, the oth satellites did not appear be than this, which was seen w the reflecting telescope thro' mist, *Jupiter* being low, and *crepusculum* strong.
May 10.	12	55	54	Emersion of the first satell by the reflecting telescope; serene; the observation certai
26.	11	14	5	Emersion of the first satel by a telescope of 13 foot, cl dy,
Dec. 24.	18	4	30	Immersion of the first sa lite by a 13 foot telescope good observation.

xperiments on perforating the Thorax, *and the Effects thereof in respiration; by Dr.* William Houston. Phil. Transf. N° 441. p. 230. *Translated from the* Latin.

xp. 1. APRIL 1728. Dr. *Houston* with a narrow scalpel made a puncture on each side of he *thorax* of a small dog, and yet the animal barked and owled no less strongly than he had done before; and gave o signs of a faulty respiration: Whence some of the assistants ispected, that the instrument had not been plunged deep nough into the cavity of the *thorax*: To remove this suicion, he made two other punctures; but the success was ntirely the same: For, both his voice and life continued und and entire from 9 o'clock in the morning, till about six the evening, when he was kill'd, in order to observe what ad happen'd.

Upon opening the *thorax*, the four wounds of the memrane, that surrounds the ribs easily appeared; so that evey one of them had penetrated into the cavity of the *thorax*. ut upon inflating the lungs, no default appeared in them, ho' the knife had penetrated almost an inch into their avities; nor did the air expire faster than it usually does ut of the soundest lungs.

Exp. 2. In *August* the same year, the Doctor made the me experiment on two puppies about four days old, y punctures on each side of the *thorax* in the one, and arge wounds in the other, so that the lungs came to view on ach side, yet they did in no manner subside, but rather eem'd to be protruded externally. Both animals continued owling for $\frac{1}{4}$ of an hour, when an end was put both to their fe and misery.

Exp. 3. About the beginning of *November* the same year, he Doctor opened the *thorax* of a middling dog, by a large ound on each side: And passing his finger through the pertures into each cavity of the *thorax*, he felt the lungs ollapsed in such manner, that the space between them and he membrane that surrounds the ribs was about an inch: wo other students of physick likewise passed their fingers hro' the apertures, and affirmed they perceiv'd the same hing: But upon loosing the dog, he immediately got up retty chearful, ran through the room, and howl'd: No tents ere put into the apertures, nor any thing upon the wounds efore next day, when bolsters with turpentine were ap-

plied. The dog being kept for three days after was so fa
from losing his voice, that his howling became pretty trou
blesome, and at length being let loose, he ran away.

Exp. 4. *January* 14. 1729, the Doctor having procured
young dog, had a mind to open the *thorax*, and give a pa
sage to the air, without wounding much the skin and muscle
to prevent a troublesome hemorrhage, and unnecessary pai
By means of the instrument called *trois quarts*, he introduce
a goose-quill pipe into each cavity of the *thorax*, with
piece of leather fixed to it, done over with pitch, that i
might stick to the skin, after first shaving it, and thus retai
the pipe: But the moveable *cutis* soon extracted it out of th
cavity of the *thorax*: And tho' he attempted the same thing
by new punctures, it always proved unsuccessful: Then h
separated on each side by a long incision the cutis, and after
wards cut asunder the intercostal muscles, and penetrated in
to both cavities of the *thorax*, as appeared by the air vio
lently rushing out:

The day following he put into the orifices tents of cor
which being thicker at each end, and slenderer in the middl
required neither bandage nor plaister to keep them on: An
yet the dog neither died, nor lost his voice, but eat, dran
and seem'd to be pretty well, only he could scarce lie on h
side, on account of the uneasiness of the wounds, especiall
the tents. Upon pulling out these latter, a passage
times was given the air, nay, one side was blown into thr
the pipe. After the dog had continued so for two da
without having his voice sensibly impaired, on the 3d da
both the tents were of a sudden forcibly expelled; an
the air passing and repassing freely through the orific
made such a hissing, that the dog, partly frighten'd, as
seem'd, with the noise, and partly afraid of being furth
hurt, run away and hid himself under the bed. Up
taking him out from thence, the Doctor again put the ten
into the wounds, but in a little time after they flew out agai
And in this condition he liv'd from 10 o'clock in the mor
ing till about five in the evening, when next day (being t
fourth from the perforation of the *thorax*) he was strangled
he gave no signs of a faulty respiration before the end of t
3d day, at which time he was a little short-winded.

Upon opening the *thorax*, it contained a pretty large qua
tity of sanies on each side. The lungs were contracted in
a narrow compass, and so far as the Doctor and such

we

e present could observe, they were whole on one side, l wounded on the other.

For farther satisfaction about this matter, Dr. *Van Swieten* *Leyden* made the following experiment, at which Dr. *uston* was present.

Exp. 5. *January* 25, 1729 having tied upon a board a ddle-sized dog, and opened the *thorax* by making a large und on each side; the dog did not lose his voice, and lungs were so far from being collapsed that a lobule of m on each side burst out through the aperture; these ules thus sticking out ceased not to dilate and contract; what was most surprizing, their dilatation was synchronal he contraction of the *thorax*, and *e contra*; upon blowing the cavity of the *thorax*, the respiration was no ways t. After the dog had liv'd in this manner for half an r, without having the voice or respiration sensibly imred, the *thorax* was farther opened on one side, by cutg asunder a rib; and then it appeared, that the lungs ich is greatly surprizing, contract, while the *thorax* dis, and *e contra*. The dog likewise survived this operan, till after all the company were satisfied about the mat he was condemned to be strangled.

The unexpected phenomena of these experiments made *Houston* try the following one in company with some nds; in order to examine whether the lungs always apd to the membrane of the *pleura*, whilst the *thorax* was re.

Exp. 6 After extending and tying down firmly upon a board mall dog, and raising up the skin, we cut a piece off with air of Scissars in that part of the *thorax*, where the ribs least cover'd by the incumbent muscles. Upon wiping the od, and stopping its flux with spirits of wine, we cut off h a pair of pincers all that cover'd the ribs and intercostal scles; and at length we carefully separated the intercostal scles themselves. The *pleura* being laid bare in this man exhibited the following phenomena. During the dilaon of the breast, a kind of white body appeared to apply the inside of the *pleura*, but upon its contraction, and the mal's expiration, that white body flying upwards gave e to a certain ascending red body, and then the breast mediately dilating itself, the red body descended again, the white one succeeded in its room, and thus alternately. on this, we likewise bared of its muscles the upper inter-

stice

ſtice of the ribs, but in that place there appeared nothing b the white body. During the dilation of the breaſt, the *ple* became concave in each part where it was bared, and dur its contraction, a little, but ſcarce ſenſibly, convex.

After having ſufficiently viewed all this, and cut aſund two ribs, we open'd the breaſt by making ſo large wound that almoſt all the contents of that ſide appear'd the eye: Upon this the animal no longer emitted a cry, th the *thorax* on the other ſide was untouch'd: The lobe ſuddenly much collapſed; but did not entirely loſe its alte nate motion of dilatation and contraction; and according every one preſent its dilatation was ſynchronal to the cont tion of the *thorax*, and *è contra*: At length the ventricle the heart was penetrated for the finger to feel its muſcu force: And thus at once a period was put to the dog's ſpiration and life.

Dr. *Houſton* was formerly of opinion that man, or other of the more perfect animals, (for, the caſe is other with frogs, *&c.*) could not live upon admitting air into b cavities of the *thorax*: But the falſity of this opinion ſufficiently evinced by the above-mentioned experimen and at the ſame time they ſeem to be repugnant to the nion of reſpiration generally receiv'd, namely that the lu are dilated by the weight of the air entering thro' the rynx, when its preſſure is taken off their external ſuperfi by the dilatation of the *thorax*: But he thinks that this parent repugnancy may be removed, or at leaſt leſſen'd the following manner.

Let us ſuppoſe, that both wounds are double the apert of the *glottis*; but that the lungs are entire, and deſtitut all contractile force; and now let the *thorax* be dilated filled by the lungs diſtended with air, then;

1. Upon the firſt contraction of the *thorax*, the air eſcape through the *glottis*.

2. When the *thorax* is again dilated, the air will ente the proportion of its increaſed capacity; but it will not enter thro' the *glottis*, nor all thro' the wounds, but thro each aperture proportionally; and the quantity, ente through the *glottis*, will be to that entering through wounds, as the aperture of the *glottis* to the ſum o apertures of the wounds; or in the preſent caſe as 1 t Therefore, the air, with which the lungs are now inflated,

$\frac{1}{5}$ of what they would be inflated with, had the *thorax* ...mained intire.

...3. While the *thorax* is contracted a 2d time, the air should ...s out the same way it enter'd at in the preceding dilatation: ...d if the apertures continue without any alteration, the ..., that enter'd thro' the wounds, should pass through them ...cisely in the same time that the air, which enter'd thro' ... *glottis*, passes through it: So that no air will remain be...een the lungs and the *pleura*, but every thing will be in the ...me state, as at the end of the first contraction; and if $\frac{1}{5}$ ... the usual inflation of the lungs be sufficient for the life ...d voice of the animal; or if it can dilate the *thorax* five ...nes more than usual, then nothing hinders but that upon ...ening the *thorax* in this manner the animal may live and ...er his voice.

The Dr. supposed one thing entirely false, namely, that ... lungs were without any contractile force; which would ...erturn the whole, were there not a compensation some other ...y: But it is evident, that the aperture of the glottis may ... contracted or dilated at the pleasure of the animal, nay, ...actually dilated, during inspiration, but contracted during ...piration, at least when the voice is a forming; whence it ...ppens that the ingress of the air can be so much assisted by ... dilatation of the *glottis*, as it is hindred by the contractile ...ce of the lungs; and its egress so much hindred by the con...ction of the *glottis* as it is assisted by the contraction of ... lungs: And an equilibrium may be preserv'd, or the one ... the other cause prevail, according as the animal may have ...s power of changing the *glottis*, or according as he uses it: ...hich likewise agrees very well with the phenomena, for, ...en the dog howl'd, the lungs burst out through the wounds; ...d while he was quiet, they enter'd in again, and never ...peared.

As to the phenomenon of the lungs being observ'd to ...ate while the *thorax* was contracted, the Dr. takes this to ...ve been owing to no other cause than to the contraction of ... muscles of the abdomen with a vast and convulsive force, ...ereby they drove every thing upwards, and considerably ...ssen the capacity of the *thorax*; whence the air, driven from ... lower, tended to the upper parts of the lungs; and tho' ... lobe (in respect of the whole) was contracted, yet in that ...t where it regarded the wound, it was dilated.

In

In *Exp. 6.* It is ſelf evident that the white body was the lungs, and the red, the diaphragm; as alſo that the lungs fill the whole capacity of the *thorax*; and as is commonly ſuppos'd, apply their ſuperficies to its membrane.

Yet there ſtill remain other difficulties in this matter, to be remov'd by more accurate experiments, and cleared up by ingenious men.

Obſervations, aſtronomical, phyſical and meteorological, for the Year 1733, *at* Wittemberg; *by M.* Weidler. Phil. Tranſ. N° 441. p. 238. *Tranſlated from the* Latin.

A Conjunction of *Saturn* and *Mars*: On *Feb.* 5, at 7h 30 min. in the evening, both theſe planets were ſeen in a ſtreight line with *Bayer*'s E of *Piſces*, as repreſented in Fig. 23. Plate VI.

Saturn and *Mars* diſtant	2°	15′	0″
Mars and E of *Piſces*	1	12	30

Feb. 19. at 7h. 15 min. in the evening, the diſtance of *Mars* from *o* of *Piſces* towards the north was obſerv'd 1° 17′ 30.

The mildneſs of the preceeding winter in *February* and *March* occaſioned epidemical, catarrhous fevers.

Mar. 14, the cold, felt that day ſharper than ordinary, was brought by a very ſtormy north-eaſt wind that blew 2 days before.

An obſervation of a ſolar eclipſe made apart on the 2d of *May* O. S. is to be found in *Phil. Tranſ.* N° 433.

May 3, an *aurora borealis* is ſaid to have appear'd.

May 5, the cold in the night injured the vines and walnuts, and likewiſe nipt the corn every where, in the loweſt grounds, ſo that afterwards the ears had no corn in them.

June 26, in the evening, an *aurora borealis* appear'd, and it ſhot forth the uſual pyramids about 12 o'clock at night.

Oct. 27. there again appear'd an *aurora borealis*; about 7 o'clock in the evening a black arch, covered with a white *faſcia*, was obſerved under the north; at 8h. 30′ a white zone lying upon the black arch expanded inſenſibly higher, to about 40 degrees, and this lucid ſpace continued quiet till 10 o'clock. After 10, pyramidal radiations ſhot forth ſwiftly every where from the white tract, and undulating clouds alſo roll'd along the heavens, but the entire white edge was ſometimes obſerv'd to riſe like a lucid wave towards the pole. This undulation of the

ſhining matter, by pyramidal rays, much brighter than that ning tract, afterwards blending therewith, laſted till 11 o'clock: e whole ſhining matter gradually moved towards the eaſt, in room of which ſucceeded black diſcontinued clouds towards weſt. A little before 11 a white cloud ſhone for a longer e near the north-weſt, and afterwards it became red, and its tter likewiſe had an undulatory motion. The ſcene vaniſh'd er 11 o'clock; the air, all the time of the appearance was m; and the ſtars ſhone every where thro' the white tract: hat ſeemed remarkable to M. *Weidler* was, that the very t day prov'd dark and rainy; as alſo that in the night after 29th there blew an exceeding ſtormy wind; ſince at other es after the more remarkable *auroræ boreales* there uſually ceeds more ſerene weather.

The ſame phenomenon of an *aurora borealis* was likewiſe ob- v'd at *Stockholm* in *Swedland*.

n Account of the crooked and angular appearance of the ſtreaks or darts of Lightning *in* Thunder-ſtorms; *by Mr.* Logan. Phil. Tranſ. N° 441. p. 240.

MR. *Stephen Hales* in his *Statical Eſſays*, Vol. II. p. 291. mentions this phenomenon of the ſtreaks or darts of htning in thunder ſtorms appearing crooked and angular, a thing not hitherto accounted for: and therefore, he eſſes at a ſolution of it.

The clouds are generally diſtinct collections of vapours, e fleeces; and therefore, the rays of light through them uſt paſs through very different denſities; and accordingly ffer very great refractions: From thence therefore, that pearance muſt undoubtedly ariſe. For, it is highly abſurd imagine, that fire darted with ſuch rapidity can form any ſignable cauſe deviate from a right line, in the manner it pears to us: And this, if duly conſidered may probably be nd a plenary ſolution.

bſervations on the aurora borealis *made in* England; *by* M. Celſius. Phil. Tranſ. N° 441. p. 241.

EPT. 13, 1735, in the town of *Woodford*, 6 miles to the north-eaſt of *London*, at half an hour after 11 at night ere appear'd a bright *faſcia*, almoſt parallel to the horizon; d its middle was judged to be under *η* of the *great bear*. At nes another light ſhot along the great bear; but almoſt con- ntly cover'd γ and δ.

Oct. 4. In *King-ſtreet*, *Bloomsbury*, *London.*

	h	′	″	
At	9	22	0	*p. m.* a ray or ſtream of light appea under the polar ſtar, perpendicular to t horizon.
	9	24	13	That ray diſappear'd.
	9	27	6	Two perpendicular rays ſhot forth 5 or degrees from the north towards the eaſt.
	9	28	30	A whitiſh ray ſhot forth again exa under the polar ſtar.
	9	30	0	That ray moved weſtward.
	9	31	0	It was ſeen under η of the great bear.
		31	27	It entirely diſappear'd.
	9	36	8	A ray aſcending perpendicularly by polar ſtar, and α and β of the great bear
	9			
	9	40	0	The ray ſeemed to move gradually u ξ of the great bear.
	9	44	0	No more rays appear'd: But whe there were any remains of light near the rizon, or in the weſt, M. *Celſius* could ſee, by reaſon of the neighbouring houſ

Oct. 11. in *London.*

	h	′	″	
At	10	37		*p. m.* There were two bright rays u and ε of the great bear.
	10	39	0	A ray between ε of the great bear an polar ſtar.
	10	39	30	A ray in form of a pyramid abov the great bear.
				Theſe rays had not any motion paral the horizon; but they entirely diſappea

Jan. 11. 1735-6 in *London*

	h.	′	″	
At	10	0	0	*p. m.* an indifferently bright arch, p wards the edges, appear'd 16 degrees one of its ends deſcended eaſtward u of the great bear: And lucid ſtrea pear'd now and then over this arch.

h.	′	″	
11	13	0	Under this arch was another very bright tract parallel to it, 5 degrees above the horizon; in which tract there were rays that shot from the west towards the east.
11	15	0	This arch was very faint.
11	17	0	The first arch became brighter, and the lower arch was almost blended with the upper, and broken in the middle.
11	20	0	The whole arch was beset with faint rays.
11	21	0	One of the rays under the polar star.
11	27	0	No arch, nor rays, but here and there bright tracts.
11	36	c	The light reach'd up to the polar star, and somewhat higher.
11	44	0	A lucid ray under the polar star.
12	11	0	The sky was overcast with clouds, except one lucid streak which appear'd 3 or 4 degrees to the east of the north.

Feb. 16. in *Clare-hall Cambridge*

At a quarter past eight in the evening, the moon shining very bright, there appear'd 2 perpendicular streams between the great and little bear.

April 3. at *London*.

h.	′	″	
At 8	46	0	M. *Celsius* observ'd a lucid arch one degree broad, which extended along the northern crown, the *belt* of *Bootes*, the *coma Berences*, the lesser *Lion* and *Cancer*, as far as the smaller dog.
8	49	36	This arch quite disappear'd: But at the same time he observ'd another broader and brighter arch under *Cassiopeia*, 7 or 8 degrees high.

In the observations of *October* 4. and in the last, M. *Celsius* is certain as to the time of the clock: So that if others have observed the same phenomena, the longitude of places may be determin'd by them with greater exactness than by *Jupiter's* satellites; which he takes to be the principal use that may be made of these observations, especially in making maps of the northern countries, where these *lights* do more frequently occur.

Some Experiments made on mad Dogs, *with* Mercury; *by* *Dr.* Robert James. Phil. Transf. N° 441. p. 244.

THE following is an account of fome experiments made on mad dogs with mercury, which Dr. *James* has fome reafon to believe is the moft effectual prefervative, and perhaps, even a cure for the *hydrophobia.*

About *Michaelmas*, 1731, Mr. *Floyer* of *Hints* complain'd that he was afraid of a madnefs amongft his fox-hounds: For, that morning one had run mad in the kennel. The Dr. took this opportunity of telling him, that he had long believ'd that mercury would, if tried, prove the beft remedy againft this infection: Mr. *Floyer* neglected this advice till the *February* following. Mean time he tried the medicine in *Bates*, commonly known by the name of the pewter-medicine; as alfo every thing elfe that was recommended to him by other fportfmen, but to no purpofe: For, fome of his hounds run mad almoft every day after hunting. Upon this he took his hounds to the fea, and had every one of them dipt in the falt-water; and at his return, he brought his pack to another Gentleman's kennel, 6 miles diftant from his own. But notwithftanding this precaution, he loft 6 or 7 couple of his dogs in a fortnight's time. At length in *February* Mr. *Floyer* tried the experiment the Dr. had recommended, upon 2 hounds that were mad, and both very far gone. They refufed food of all forts, particularly fluids, flaver'd much, and had all the fymptoms of a *hydrophobia* to a great degree. That night he gave 12 grains of turpeth mineral to each of the 2 dogs, which vomited and purged them gently. Twenty four hours after this, he gave each 24 grains; and after the fame interval he gave 48 more to each. The dogs falivated very much, and foon after lapp'd warm milk. At the end of 24 hours more he repeated to one dog 24 grains more, and omitted it to the other. The dog, that took this laft dofe, lay upon the ground, falivated extremely, was in great agonies, and had all the fymptoms of a falivation rais'd too quick; but got thro' it: The other relapfed and died.

To all the reft of the pack he gave 7 grains of the turpeth for the firft dofe, 12 for the 2d dofe, at 24 hours diftance, which was repeated every other day for fome little time. The method was repeated at the 2 or 3 fucceeding fulls and changes of the moon. From this time he loft not another hound; and tho' feveral afterwards were bit by ftrange dogs, the turpeth always prevented any ill confequences.

The

The Dr. and his friends tried the same thing upon a great any dogs, and it never fail'd in any one instance: Tho' dogs, at the same time and by the same dogs, have run mad after st other medicines had been tried.

As to the experiments on mankind, the Dr. had opportuni-s of making but 3.

The first was on a girl about 14 years of age: The calf of r leg was torn by a mad dog in such a manner, that the sur-on was obliged to use means to prevent a mortification from bite: She was vomited by the turpeth: Three days before next change of the moon, the vomit was repeated, and ain the very day of its changing. The same method was pur-d the next full moon. The girl was very well.

The second was on a boy of about 10 years of age. He had holes in one of his legs, made by a mad dog. The turpeth as given as above, and the wounds dress'd with digestives, d he continues well.

The third case was that of a young man, of about 18 years age: The bite was upon the hand. A great number of gs were bit at the same time in the town where he liv'd. bout 6 days after the mischief was done, several dogs, that d been wounded, ran mad; upon which he applied himself Mr. *Wilson*, apothecary in *Tamworth*, to whom the Dr. had mmunicated the success of the turpeth in this case. The ung man was at this time very melancholy and dejected, had emors, and slept very little for some nights before, tho' he as not apprehensive that the dog which bit him was mad. He d a dry scab upon his hand: Upon applying to Mr. *Wilson* e was vomited with *Vin. Benedict.* ℥ij.

The next thing he took was made according to the following escription.

℞ *Turpeth Min. gr. XII. Lap. Contrayerv.* ℈i. *Ther. Androm. q. s. M. F. Bol.* N° 3, *sumat unum singulis noc-ibus horâ decubitûs suprabibendo Julap. seq. cochl. IV.* ℞ *aq. Rut.* ℥vj. *Theriac.* ℥ij. *Syr. Pæon. c.* ℥iss. *Tinct. astor.* ℈ij. *M. F. Julap.*

Upon taking these the patient sweat very much, and had 2 ose stools every day after them. His tremors went off, and he ept better. After this he went into the cold bath, and conti-ued perfectly well.

But what is remarkable in this case is, that the wound ran a hick digested matter after this method, and threw off the scab ke an *escar*; after which it heal'd of itself.

The

The Dr. makes an observation or two on the antiquity of th disease, which he the rather chooses to do; because *Cælius A relianus*, in his account of it, does not seem to build so mu upon the authority of *Homer*, as, in the Dr's opinion he mig have done. He quotes, it is true, a passage out of the 8 *Ilia* where *Teucer* calls *Hector* κυνα λυσσητηρα, but does not see to think this sufficient to prove that *Homer* was acquainted wi this madness. But he omits 2 more passages in the same au thor, which, joined with this, amount to a demonstration th *Homer* was by no means ignorant of it. The first is in t 9th *Iliad*, *l*. 237 where *Ulysses* is upon his embassy to *Achill* and describes to that hero the distress of the *Grecian* army th his absence; and when he has painted *Hector* as terrible as can, he compares his fury to the rage of a mad dog.

> ——— Ἑκτωρ δε μεγα σθενεϊ βλεμεαινων
> Μαινεται εκπαγλως, πισυνος Διϊ, ουδε τι τιει
> Ἀνερας ουδε Θεους, κρατερη δε ε λυσσα δεδυκεν. *i. e.*

> ——— *Hector vero valde trucibus oculis adspiciens*
> *Furit terribiliter, fretus Jove: Nec quicquam honorat*
> *Viros neque Deos; ingens autem ipsum rabies invasit.*

If *Homer* had designed to describe a mad dog as a physici he could not have expressed his looks by a more proper t than Βλεμεαινων. It must also be consider'd, that this disco is directed to *Achilles*, who, having studied physic under *C ron*, was consequently more capable of receiving an idea of mischief *Hector* did to his countrymen by this metaphor.

In the 13th *Iliad*, *Hector* is again call'd Λυσσωδης by *N tune*.

It must be observed that λυσσα, λυσσητηρ and λυσσω can properly and in their natural signification be applied t other madness than that peculiar to a dog, tho' metaphoric it may, as in the instances the Dr. has given, as also in *Sop cles* and *Euripides*. The term λυσσα or λυττα is use *Aristotle*, *Galen* and *Dioscorides*, to signify the madness of d And Λυσσοδηκτος is used by the last mentioned author to sig a man bit by a mad dog. Λυσσαω is used by *Aretæus* in sense, and Λυττωσαις by *Plutarch* to express the same thin

What the Dr. would infer from this is, that *Homer* was tainly acquainted with the madness of dogs; and if dogs i days ran mad, it is probable they would bite men; and if

be sure, an *hydrophobia* would be the consequence: And yet *utarch* will have it, that it was first taken notice of in the ys of *Asclepiades*, famous for his practice in *Rome* before death of *Mithridates*.

Another strong evidence of its antiquity is that instinct which ects every dog to avoid a mad dog upon smelling, seeing, or n hearing him. If this be not instinct, it is reason, and that a higher degree than we ourselves can pretend to. Now innct must be coeval with the creation, or at least the fall; and erefore, madness must not be much younger.

Catoptric Microscope; *by Dr.* Robert Barker. Phil. Trans. N° 442. p. 259.

THO' microscopes, composed of refracting glasses only, have been vastly improved, as to their effects of magniing; yet they have been attended with such great inconveencies, that their application to several arts, in which they ight be very convenient, is not so common as might be execed; and mankind have reap'd but a small part of the adntage obtainable from so surprising and useful an instrument.

Among the inconveniencies mentioned, the following are the ost considerable.

1. That in order to magnify greatly, it is necessary the object lass be a portion of a very minute sphere, whose *focus* being ery short, the object must be brought very near; it will, erefore, be shaded by the microscope, and not be visible by ny other light than what passes thro' itself: In this case, erefore, opaque objects will not be seen at all.

2. Objects, illuminated this way, may be rather said to clipse the light, than to be truly seen, little more being exactly presented to the eye, than the out-line; the depressions and evations within the out-line appearing like so many lights and hades, according to their different degree of thickness or transarency; tho' the contrary happens in ordinary vision, in which he lights and shades are produced by the different exposure of he surface of the body to the incident light.

3. Small parts of large objects cannot easily be applied to the icroscope, without being divided from their wholes, which in he case of vivi-section defeats the experiment, the part dying, nd no more motion being observ'd therein.

4. The *focus* in the dioptric microscope being so very short, s exceeding nice, the least deviation from it rendering vision urbid; therefore, a very small part of an irregular object can e seen distinctly this way.

To

To remedy these defects, Dr. *Barker* has contriv'd a micro-scope on the model of the *Newtonian* telescope, in which h has been very much assisted by Mr. *Scarlet* Junior. As to th effects of this instrument, it magnifies from the distance of 9 t 24 inches.

Fig. 3. Plate VII. represents the entire microscope mount on its pedestal, on a proper joint, contriv'd so as to direct th instrument towards any object.

Fig. 4. The section of the instrument, in which AB is th larger concave metalline speculum; CD the lesser concave m talline speculum; EF a hollow brass screw to fasten in the fir dioptrical glass, or plano convex glass; GH another scre fastening on the hollow cylinder EFIK (in which the dioptri glasses are contain'd) to the body of the microscope; IK a ca with a small perforation, serving as an aperture to the eye-gla or second *lens* (convex on both sides) ML a long screw passi thro' the nuts P and V, serving to bring the small *speculum* a proper distance from the larger; NQ a sliding piece mov by the screw, carrying the stem QR, and little *speculum* CD YX a screw for the cap as represented at Fig. 5; that at Fig. is to be screwed on the aperture IK.

Fig. 7. shews the construction of the microscope, in which is an object supposed erect, from which rays falling on the *sp-eculum a b*, will be reflected to the *focus k*, where they will for an inverted image, and being reflected by the small *specul c d*, they will pass thro' the perforation of the great *speculu* and falling on the plano-convex glass *e f*, converge again, a form an erect image at *l*; which being brought very near to t eye, and so considerably magnified, will be distinctly seen th the eye-glass *g h*.

An Account of the standard Measures preserv'd in the Ca-tol *at* Rome; *by Mr.* Folkes. Phil. Transf. N° 4 p. 262.

IN the wall of the capitol is a fair stone of white marb 8 foot 5 inches *English* in length, and 1 foot 9 inches and in breadth; upon which are inscribed the standards of seve measures with the following respective inscriptions.

Piede Ro: Pal. IIII. Onc. XII. Deti XVI

Piede Gr

Ca

Canna di Architet. Palmi X.
Staiolo Pal. V. Quar. III.
Canna di Merca. Palmi otto d'altra misura
Braccio di Merc. Pal. III. d'altra misura
Braccio di Tessitor di Tela

Curante Lu. Pœto

The lines, that represent these measures, are cut pretty deep the marble; but as they have, consequently, a considerale thickness, it is somewhat difficult to be very exact in king off their dimensions. Mr. *Folkes*, however, attempt to do it as near as possible, by setting the point of his ompasses in the middle of the cross lines, that are drawn to etermine the beginning and end of the measures. The alm of the architects is easier to give than the others, by ason the whole *Canna* is inscribed on the stone: This he, erefore, took off, as he presumes others have generally done, d then divided it into 10 equal parts. After this his chief tention was to the *Roman* foot, as being of greater consequence than the other measures. They all, however, follow they occur'd to him, in such parts as the *London* foot conins a thousand.

The *Roman* foot 966 +. This is divided upon the stone; st into four palms, and then on the upper part into 12 unciæ; d on the lower into 16 deti, according to the inscription.

The *Greek* foot 1006 +. This is also divided like the *oman*.

The *Canna* of the architects 7325. It is divided into 10 alms; each of which is, therefore, 732 and ½ of the *English* ot.

The *Staiolo* being five palms and ¾ is 4212.

The *Canna di Mercanti*, divided into eight palms of another easure 6 foot 9 inches $\frac{21}{40}$.

The *Braccio di Mercanti*, divided into four palms of anoer measure, 2 foot 6 inches $\frac{11}{24}$.

The *Braccio di Tessitor di Tella*, divided into three parts foot, 1 inch and ½ 4.

The palm of the architects is assigned by Mr. *Greaves* 732 the *English* foot; and the same is given by M. *Picart* to e *Paris* foot, in the proportion of 494 and ½ to 720; which,

reduced becomes 732 + of the *English* foot, as before, and as it came out from Mr. *Folkes*'s own trial.

The *Roman* foot is given by M. *Picart* from this very ston $653\frac{1}{10}$ of such parts as the *Paris* foot contains 720; that is by reduction 967 + of the *English* foot; and the same by *Fabretti*, who also measured it upon this stone, is assigned to th palm of the architects, as 2040 to 1545; which reduced upon the former measure of the palm is $966\frac{1}{2}$ of the *Englis* foot.

These measures come out as near as the nature of the standard can possibly allow; and as it was somewhat fresher in M *Picart*'s time than it is now, Mr. *Folkes* would not vary fro the proportion the former has assigned, but supposes the *Roma* foot on this marble was intended to be such a one, as shoul contain 967 parts of the *English* foot very nearly.

Mr. *Greaves* had long before assigned the measure of th *Roman* foot from *Cossutius*'s monument to be 967 of the *English* foot, and preferr'd that measure to the others he had take from the tomb of *Statilius*, and the *Congius* of *Vespasian*. An Mr. *Folkes* thinks one can make no doubt, from what has bee said, but *Cossutius*'s foot was that intended to be inscribed upo this marble; tho' that monument is itself now lost: At lea when Mr. *Folkes* was at *Rome* he could get no intelligen of it.

Fabretti in his work concerning aqueducts, where h gives the above mentioned proportion of the palm to the foo finds fault with *Lucas Pœtus*, as having made a wrong ca culation of this proportion in his book *de mensuris & ponderibus*. The proportion there given by *Pœtus*, does not, it true, agree with the foot upon the marble; but yet it is no fal calculation, as *Fabretti* thought; and had he carefully exami ned *Pœtus*'s book, he would have been sensible this is not th foot he there contends for, but the *Cossutian* foot, which *Luc Pœtus* in his book disputes against. The truth, therefor is, that he either alter'd his mind after the writing of that boo before the marble was set up; or more probably, that tho' h had the care of having these measures inscribed on the marbl he was directed by a superior authority what measures he w to have engrav'd; and that accordingly he had, as near as po sible, the *Cossutian* foot described for the ancient *Roman* fo on the stone: And that this was the case, and no mistake abo the number, as *Fabretti* supposes, appears not only from t tenure of his book, where he condemns *Cossutius*'s foot, whi

the

here appears, but also from his scheme at the latter end, where e has given what he calls *schema pedis legitimi*, agreeing with his own numbers, *viz.* 12 inches, whereof $9\frac{2}{9}$ make the alm of the architects and likewise the measure of the *Colotian* nd *Statilian* foot, agreeing with that inscribed on the marble. The *Colotian* is the same monument as the *Cossutian*; so call'd rom the person, in whose possession it had formerly been: And e had before said, p. 5. that according to the testimony of *Philander* the *Statilian* agreed with it, tho' Mr. *Greaves*, who measured both these feet very carefully, found some difference between them, stating the *Cossutian*, as above, *967*, and the *Statilian 972*. But by *Pætus*'s quoting *Philander*, it is plain, he ad not himself measured the latter: And therefore, the foot all'd by him the *Colitian* and *Statilian* is indeed purely the *Colotian*, or *Cossutian* foot; and the same has also occurred to Mr. *Folkes* very nearly from his measure of the height of the *Trajan* pillar, which he finds, from the ground to the top of he cimatium of the capitol, to be 115 foot 10 inches $\frac{5}{8}$; and his height, divided by 120, gives *966* for the quotient very early.

As to the *Greek* foot there seems to be no farther mystery, han that it was intended to be made to the *Roman* in the roportion collected from *Pliny*, which is, that *625 Roman* eet made *600 Greek*; by which account the *Greek* foot should ontain 1007 of such parts as the *Roman* contains *967*; and the ctual quantity Mr. *Folkes* took off was 1006.

ome *Observations in* 1734, *at* Wittemberg; *by* M. Weidler. Phil. Trans. N° 442. p. 266. *Translated from the* Latin.

ON the 23d of *January*, 1734, at 7h. 6m. in the evening there again appeared an exceeding bright *aurora borealis*. Under the north was seen a black arch with a double white *fascia* resting on it, distinguish'd by a black middle tract; the last white arch rose 25 degrees high; in the black tract at times were kindled shining pyramids; from the reflected light near the zenith a similar white arch was produced. At 7h 30′ the white tract was diffused a pretty way beyond he west point, and its middle reach'd 50 degrees high; at h 35′ the shining tract reach'd the *vertex*, discontinu'd clouds ere and there tended towards the west, a circumstance which eldom happens in *auroræ boreales*. M. *Weidler* was likewise urprized at some clouds, which stood about the north-east, and moved before the shining tract, beyond which clouds the light

of the *aurora* was diſtinctly ſeen: Whence it appears, that the light of the *aurora* reach'd far beyond the clouds. At 7h 38′ the ſhining tract of the *aurora* was deſcending below the horizon, eſpecially towards the weſt: This likewiſe deſerves our attention, namely, that tho' this *aurora* was exceeding bright, yet it emitted few ſhining pyramids. At 8h 30′ almoſt the whole light was ſet below the horizon; yet ſtill near the weſt it was 10 degrees high; the tract of the black arch, together with the ſmall white impending *faſcia* was ſtill ſeen at 10 o'clock under the north.

On the 27th of *January* at 6h. 23′ in the evening, there was obſerv'd a conjunction of the moon and *Venus*. M. *Weidler* found the angle of *Venus* 35′ of a degree. *Venus* regarded the ſouth, and the Moon the north; at 6h 57′ the angle of *Venus* was = 26′; and in this obſervation a line drawn thro' *Venus* and both the cuſps of the moon was a right one; afterwards the moon gradually elongated from *Venus*.

On the 17th of *February* the lowneſs of the mercury in the barometer was remarkable, being at 28 inches 7 lines, such as M. *Weidler* never before obſerv'd in theſe parts; from this might be preſaged that terrible ſtorm of wind, that ſeem'd to overturn every thing in its way; at three in the afternoon great numbers of tiles were blown off the houſes; ſo that none could walk the ſtreets with ſafety. In *Saxony* and other places of *Germany* this ſtorm did a great deal of damage to the houſes, woods, and gardens, pull'd up by the roots an incredible number of trees, broke down old oaks and other trees; and men in the open fields could not ſtand on their legs.

On the 19th of *March*, at 6h 45′ in the evening about the N. N. W. there appeared a black arch, lined with a broad white *faſcia*; whoſe light was brighter towards the weſt than towards the eaſt, but without ſuch ſhining pyramids or waves, as uſually accompany *auroræ boreales*: There are, therefore, ſome *auroræ boreales*, that only ſhew a white tract under the north, but without any motion of the light.

On the 29th of *March* there appeared a remarkable *aurora borealis*, which M. *Weidler* firſt obſerv'd at 9 o'clock. The moon was inclining to the weſt, and only ſhone through the clouds; almoſt the whole heavens were overcaſt; and yet after the clouds divided, there was a ſhining tract about the north point, from which at times ſhot ſhining pyramids, an infallible ſign of an *aurora borealis*: He likewiſe found

behind

[beh]ind the clouds a ſhining tract of the *aurora* become an [arc]h. The ſhining pyramids might be ſeen till 11 o'clock; [an] uncommon ſight to obſerve an *aurora borealis* when the [sky] is cloudy, and a wind blows, whereas at other times it [com]monly appears only when the ſky is ſerene and calm.

On the 9th of *Auguſt* as M. *Weidler* was to obſerve *Sa-* [tur]*n*, at 11 o'clock, ſome thin clouds that hung about the N. E. and N. b. E. ſeemed to be on fire all of a ſudden. [Bu]t after emitting a few radiations towards the vertex, the [shi]ning ceaſed, and little clouds were driven by a gentle [win]d towards the eaſt.

From theſe and other obſervations it plainly appears, how [var]iable a phenomenon the light of the *aurora borealis* is.

OB-

Observations *made on the* Latitude, *variation of the* Needle *and* Weather, *in a Voyage from* London *to* Hudson's-Bay, *Ann.* 1735; *by Cap.* Christopher Middleton. *Phil. Trans.* No. 442. p. 270.

Month.	Day.	Hour.	Altit. of the Thermometer.	Altitude of the Barometer,	Lat. by Account.	Longitude from *Lond.* Acc.	Variat of the Compass	Lat. observ. by *Smith's* Quad.	Lat. observ by *Hadley's* Quad.	Latit. observ'd by *Elton's*. Quad.	Latit. by a Sextant of *Ward* & *Smith*	Winds.	Remarks.
			° ′	° ′	° ′	° ′	W.	° ′	° ′				
		6	27	29. 9								S W	
May	31	12	24	29. 6	60. 0	19.11	23		-			to	Variable, with some rain.
		9	29	29. 7								S E	
		6	29. 7	29. 7								S E	Variable the first two parts, moderate the latter, fresh gales and a great sea.
June	1	12	25	29. 5	59.50	23.33	24					to	
		9	25	29. 5								S W	
		6	26	24. 4								S W	
	2	12	26	29. 3	59.55	25.53	25	59.54	59.59			to	Cloudy and squally with rain.
		9	27	29. 8								S by E	
		6	28	29. 9									Frequent showers of rain, with squalls.
	3	12	26	28. 8	60	28. 3	26	59.57	60			S W	
		9	27	30. 1									
		6	29	30. 5									
	15	12	26	28. 8	28.25	60.40	27	60.39	6 .41			S W	Uncertain squally weather with a western swell.
		9	27 9	30. 1									

June 5	12	28	29. 8	58.31	32.12	27					S W	Squally, with ſome rain
	9	25	29. 7									
	6	28	29. 7								S W	
6	12	25	29. 5	58.44	35.46	27	58.47	58.50			to	Variable, with ſqualls of rain.
	9	24	29. 5								N N W	
	6	28	29. 5								N N W	Variable freſh gales, with rain and ſqualls.
7	12	28	29. 9	58.11	36.58	28	58. 8	58.11			to	
	9	30	29. 8								W N W	
	6	30	29. 9								N N W	Moderate and fair weather with clouds.
8	12	28	29. 8	57.50	38.33	28	57.53	57.57			to	
	9	26	29. 6								W by S	
	6	26	29. 9								W b S	
9	12	25	28. 9	58.28	42.16	28	58.28	58.38			to	Rain and freſh gales.
	9	26	29. 6								S b E	
	6	31	29. 8									
10	12	28	30.	58.25	43.11	29	58.16	58.22			N W	Hard gales, with a great ſea.
	9	26	30. 4									
	6	30	29. 8								N W	
11	12	27	29. 8	58.48	44.16	29	58.40	58.45			to	Moderate, with ſome rain.
	9	28	29. 9								N E	
	6	30	30								N N E	At 6 made Cape *Farewell*, from N b W to N b E 14 or 15 leagues diſtance; moderate with ſome rain.
12	12	28	29. 6	58.22	45.46	29					to	
	9	28	29. 8								W b S	

Month.	Day.	Hour	Altitude of the Thermometer.	Alt. of the Barometer.	Lat. by Account.	Longitude from *London* by Act.	Variation of the Compass	Lat. observ. by *Smith's* quad.	Lat. observ'd by *Hadley's* quadra.	Latitu: observ. by *Elton's* quadra.	Latitu. by a sextant of *Ward* & *Smith*	Winds.	Remarks
			° ′	° ′	° ′	° ′		° ′	° ′	° ′			
		6	27	29									Much ice in sight. An hard gale,
June	13	12	27	29. 7	58.12	45.37	29	58.10	58.13			N W	with a great sea.
		9	32	29. 9									
		6	31	30. 1								N N W	Most part hard gales.
	14	12	26	29. 9	58.12	46.11	30	58.10	58.11			to	Under main sail and mizen.
		9	29	30.23								E S E	
		6	29	30. 5								E S E	Saw a large isle of ice. Pleasant
	15	12	29	30. 1	59.7	49.49	31					to	weather.
		9	27	30								S E	
		6	26	30. 1									
	16	12	27	30. 1	60.14	55. 3	33					S E b S	Fresh gales, and cloudy with rain.
		9	27	29. 9									
		6	30	31								S b E	
	17	12	26	29 9	61. 7	59.43	36					to	Moderate, but hazy, with rain.
		9	26	29. 9								S E b S	
		6	31	29. 9									Hazy, with rain and fogs; several
	18	12	28	29. 5	61.23	63. 7	39					S E	pieces of ice.
		9	27	29. 7									
		6	27	29.85								S E	Foggy, with calms. Much ice all
	19	12	31	30	61.47	63.16	39	61.44	61.49	61.54		S S W	round *Resolution.*
		9	30	29 9								S b E	

June

June 20	12	29	30	61.40	64. 8	39			61.46		Wt SWbS	Moderate weather, most part foggy.
	9	30	29. 8									
	6	29	29. 8								Wt	Much ice all round; fore part foggy, latter clear.
21	12	29	30. 6	61	64.34	39	61. 4	61. 5	61.12		W N W	
	9	29	30. 8								N b W	
	6	32	29									The most part foggy and hazy weather.
22	12	27	29. 4	61.11	65.40	40	-	61	61.12	61.12	N b W	
	9	28	29. 9									
	6	30	29. 9								So	Fair, with much shatter'd ice, and large isles.
23	12	27	29. 8	61 30	66.50	40			61.30	61.30	S W	
	9											
	6											Easy breezes, fair and clear, heavy ice all round.
24	12	24	29. 8	61.37	67.19	41	61.36		61.38		W N W	
	9	26	29. 6									
	6	28. 5	29. 9									
25	12	27	29. 6	61.53	68.12	42					Ditto	Hazy middle part, clear the latter.
	9	28	29. 8									
	6	28	29. 7									
26	12	27	29. 8	61.41	68.42	41					SW b W	Fair pleasant weather; much ice.
	9	30	39. 9									
	6										N N E	Little winds, and fair pleasant weather.
27	12	29	29. 7	61.30	68 42	41					W S W	
	9	29	29. 6									

Month.	Day.	Hour.	Altitude of the Thermometer. ° '	Alt. of the Barometer. ° '	Lat. by Account. ° '	Longitude from *London* by Act. ° '	Variation of the Compass.	Lat. observ. by *Smith's* quad. ° '	Lat. observ'd by *Hadley's* quadra. ° '	Latitu. observ. by *Elton's* quadra.	Latitu. by a sextant of *Ward* & *Smith*	Winds.	Remarks.
		6	31	29. 8									
June	28	12	29	29. 6	61.33	69. 2	40						Most part foggy, with calms.
		9	29	29 75									
		6	28	29. 5									
	29	12	27	29. 6	61.30	69.13	40	61.30		61.30	61.20	ESE	Several large isles of ice; foggy.
		9	25	29.75									
		6	26	29. 9								ESE	Little winds and calm; heavy ice all round.
	30	12	26. 5	29. 5	61.33	69.26	40					to	
		9	27	19. 9								WSW	
		6	29	29. 9									Fast in thick ice, with fogs and rain.
July	1	12	27. 5	29. 7	61.28	70.10	41					ESE	
		9	27. 5	29. 6									
		6	32	29. 1								SE	These 24 hours the first and latter parts fresh gales, middle a Storm of wind and rain.
	2	12	31	29	61.28	70.37	41					to	
		9	26. 5	29. 3								NE	
		6	29. 5	29. 5									
	3	12	28	29. 8	61.28	70.22	41					NW	Hard gales, with much snow.
		9	27. 5	29. 9									
		6	32	29. 9								NW	Moderate and fair weather, with much ice.
	4	12	29. 5	29. 6	61.28	70.26	40					N b W	
		9	25. 5	29. 3									
		6	29	29. 8									
July	5	12	27	29. 9	61.39	70.36	40	61.33		61.44	61.43	W b S	Working to windward in ice, sometimes in a clear.
		9	29	29. 7									

July	5	6	29	29. 8	61.39	70.36	40	61.33		61.44	61.43	W b S	Working to windward in ice, sometimes in a clear.
		12	27	29. 9									
		9	29	29. 7									
	6	6	31	29. 9	61.46	70.54	40		61.54		61.53	W S W to N E b N	Most part fair and pleasant weather, with much ice.
		12	27. 5	29. 7									
		9	26	29. 7									
	7	6	27	29. 4	61.55	71.13	40					N E to N W b N	Foggy weather, close ice all round.
		12	27	29. 6									
		9	27	29. 9									
	8	6	29	29. 7	61.46	70.21	40					Ditto.	Moderate, with fogs.
		12	26	29 75									
		9	25. 5	29. 9									
	9	6	29	29. 9	61.42	71.40	41			61.38		Ditto.	The first part hazy, the latter clear.
		12	27	30									
		9	27	30									
	10	6	32. 5	29. 7	62.18	75.13	41					N W to S E	Clear sea, fresh gales and hazy.
		12	29. 5	29. 6									
		9	26	29 75									
	11	6	31	29. 7	62.31	76	42					S b W	Foggy weather.
		12	27	29. 9									
		9	28	29 75									
	12	6	31. 5	29. 9	63. 5	75.28						Ditto.	Ditto.
		12	31. 5	29. 9									
		9	28	30									

Month.	Day.	Hour.	Altitude of the Thermometer.	Alt. of the Barometer.	Lat. by Account.	Longitude from *London* by Act.	Variation of the Compass.	Lat. observ. by *Smith's* quadra.	Lat. observ. by *Hadley's* quadra.	Lat. observ. by *Elton's* quadra.	Lat. by a sextant of *Ward* & *Smith*	Winds	Remarks.
			° ′	° ′	° ′	° ′		′	° ′	° ′	° ′		
		6	30	30. 2								S	Working in loose ice; hazy, sometimes clear.
July	13	12	29	30. 3	63.15	75				63.20		to	
		9	27. 5	29. 9								N W	
		6	31	30								N W	Much ice, fair and clear, with calms.
	14	12	27	30	63.25	74.38						to	
		9	25	30								West	
		6	30	29. 9								S S E	
	15	12	27	29. 8	63.20	76						to	Much ice, fresh gales and hazy.
		9	27	29. 8								E S E	
		6	27	29. 8									Loose ice, large clears in sight of *Salisbury*.
	16	12	26	29. 7	63.10	77.20						S E	
		9	26. 5	29 7									
		6	27. 5	29. 7									
	17	12	27. 5	29. 6	63.10	78.20	44					E S E	Foggy, much ice and fresh gales.
		9	26	29. 7									
		6	29	29. 6									Loose ice, east end of *Nottingham*. N b E seven leagues
	18	12	26	29. 8	63	78	43					Calm.	
		9	26	29. 8									
		6	25	29. 9									Much ice, clear weather. Cape *Walsingham* S W b W five or six Leagues.
	19	12	24	29.85	63.10	78.20	43					E S E	
		9	27	29.80									

July

July 20	6	28		29.85	63.20	78.30	41					S W	Shatter'd ice, foggy weft; Ifland *Diggs*, W S W five leagues.
	12	27.	5	29.84									
	9	27		29. 9									
	6	27.	5	29.98								S S E	Cape *Diggs* S E b S 6 leagues. Frefh gales, and ice.
21	12	25.	5	29. 9	63.10	79.50	42						
	9	24		29. 8								S b W	
	6	27		29. 9								S W b W to South.	Much large ice; the north end of *Mansfields* S W b W four miles.
22	12	25		29. 9	63	80.13	42						
	9	23.	5	30. 1									
	6	26.	5	30. 1								S W	North end of *Mansfields* S W fourteen miles.
23	12	26		30	63. 4	81.10	44			62.52			
	9	25		30									
	6	29.	5	29. 9								E b S to S S E	Hazy; fome pieces of ice.
24	12	29.	5	29. 9	61.34	82.52	40			61.26			
	9	26		29.85									
	6	31		29.82								S S W	Much ice and rain.
25	12	28		29.82	61.15	83.56	38			61.14	61.17		
	9	26		29.83								S b E	
	6	32		29. 7								S b E to W b N	Thick foggy weather, with fhowers of rain.
26	12	29		29. 7	60.45	84.23				60.41			
	9	29.	5	29. 9									
	6	30.	5	29. 9								N W to Weft.	Steering ice, with wet fog.
27	12	26		29. 9	59.39	84.11	30	59.36		59.34			
	9	26		30. 1									

July

Month.	Day.	Hour	Altitude of the Thermometer. ° ′	Alt. of the Barometer. ° ′	Lat. by Account. ° ′	Longitude from *London* by Act. ° ′	Variation of the Compass	Lat. observ. by *Smith's* quad. ° ′	Lat. observ'd by *Hadley's* quadra. ° ′	Latitu. observ. by *Elton's* quadra. ° ′	Latitu. by a sextant of *Ward* & *Smith*	Winds.	Remarks
		6	28	30. 1									*Baker's Dozens* S b W four leagues.
July	28	12	26	30. 1	58. 9	82.44	28	58. 5	58. 2			N bW	Fair weather.
		9	26	30 1									
		6	28	30.									Moderate, with fogs, rain and ice.
	29	12	26	30.	56.46	82.45	26			56.30		W b S	
		9	25	29.95									
		6	27. 5	29.85									Fresh Gales. A great sea from the
	30	12	25. 5	29. 9	55.51	82.39	25					N W b W	southward.
		9	23	30									
		6	26	29. 9									Thunder and rain. *North-Bear*
	31	12	25. 5	29. 5	54.44	82.47	24					NE	S W by W five miles.
		9	24	30									
		6	26	30									
Aug	1	12	25. 5	29.98	53. 3	81	22					NE	Moderate and fair weather.
		9	23	29.85									
		6	24	29. 8								South	The first part moderate, the latter
	2	12	23. 5	29. 9	52.20	82						to	hard gales, with thunder and light-
		9	24	29. 9								North	ning in with the W. main.
		6											
	3	12	26	30	51.40	83							Arrived in *Moose-river* road.
		9											

Aug.

											Winds.	
Aug. 4	6											
	12											
	9											
Sept. 1	12	27	29.85	55.36	West 00 24	22					West and W b N	Moderate and fair.
	9	29	29.85		from						N W	Moderate gales and hazy, with
2	12	27	30. 5	53.50	Btar.	26					to	small rain.
	9	26	30. 8		1.16						North.	
	9	●	29. 8								N b W	
3	12	26	30. 4	56. 6	1.16	26					to	Ditto.
	9	23	31. 5								N b E	
	9	30	29. 8								South	The first part moderate, middle and
4	12	26	30. 6	58. 6	2 58	30					to	latter very hard gales, with
	9	23	31.								East	squalls of rain.
	9	33	29 8									
5	12	33	29.85	58.28	4.26	30					N E b E	Ditto, hard gales and squalls.
	9	34	30.									
	9	33	30. 1								E N E	Fresh gales and squally, with a
6	12	32. 5	30. 2	58.40	3.23	31	58.42	58 49			North	head Sea.
	9	32	30. 2									
	9	27	29. 9									
7	12	27	29. 8	60.45	1.15	31					N W	Ditto gales and snow
	9	26	30. 1									

Month.	Day.	Hour.	Altitude of the Thermometer.	Alt. of the Barometer.	Lat. by Account.	Longitude from *London* by Act.	Variation of the Compass.	Lat. observ. by *Smith's* quad.	Lat. observ'd by *Halley's* quadra.	Latitu. observ. by *Elton's* quad.	Latitu. by a sextant of *Ward* & *Smith.*	Winds.	Remarks.
			°	°	°	°	°	°	°	°	°		
		9	37 5	30. 3		East.						S W	Strong gales and squally ; great sea
Sept.	8	12	35	30. 2	61.37	0. 4	32					to	from the north-west.
		9	32	30. 1								N W	
		9	34	30. 3		East						N W	Moderate and fair ; four leagues
	9	12	32 5	30. 3	61.55	0. 4	33					to	from the south end of *Mansfields*
		9	32	30. 5								N N E	76 Fathom, Mud.
		9	32	30. 5		West.						N b E	Little Winds and fair Weather.
	10	12	29	30. 5	61.58	1. 0	34	61.43	61. 45	61.46			In sight of *Mansfields*
		9	30	30. 5								S W	
		9	36	30.25		East.							Fair and pleasant weather.
Oct.	11	12	30	30. 1	62.30	2.21	43	61.30				S W	In sight of *Mansfields*, 4 Miles.
		9	28	30.									
		9	30	30. 1		East.						W S W	At noon *Mansfields* N W b W 5
	12	12	30	30.	62.52	2.28	42					to	Leagues ; sleet and foggy. Cape
		9	30	30. 1		2.28						W N W	*Walsingham* S W 6 leagues.
		9	32	30. 3		fro. *Dig*						N W	Frequent showers of hail and snow
	13	12	33	30. 25	63. 9	3.40	43					to	
		9	32	30. 2		East.						N b E	
		9	31 5	30. 1		East.						N N E	
	14	12	29	30. 5	62.50	6. 4	42						Moderate and fair weather.
		9	31	30.								Calm.	

Sep. 15	12	30.	29.46	62 22	7.55	42	62.21	62.23			to W N W	Much fnow, with thick weather.
	9	29.	29. 5									
	9	29	29. 8								N W	Paſs'd ſeveral large iſles of ice; freſh gales and fleet: thick weather with fnow.
16	12	30	30	61.43	12	42					to	
	9	28	30. 3								N b E	
	9	32. 5	30. 4								North	Firſt two parts hard gales and fnow, latter moderate. At noon cape *Reſolut.* NE 6 L.S.Pt.NW. bN4L.
17	12	33	30. 5	61.43	15.10	40					to	
	9	31	30.55								N N E	
	9	31	30. 4		West							Many large iſles of ice; hard gales; great ſea from the north eaſt.
18	12	34	30. 3	60.40	58.40	40					N E b N	
	9	31	30. 4									
	9	33	29. 9								North	Moderate, but dark and cloudy, with fleet and rain.
19	12	26	29. 5	59.49	53.43	38					to	
	9	26	29. 5								S W	
	9	30	29. 7								N W	Freſh gales, with rain and fnow
20	12	29	29.65	58.42	48.52	32	58.37	58.38				
	9	29	29. 6									
	9	31	29. 5								N N W	Variable, with freſh gales and rain
21	12	30	29 6	57.28	44.31	29					to	
	9	29	27. 7								North	
	9	27. 5	29. 5								North	Freſh gales and ſqualls; variable winds and cloudy.
22	12	27. 5	29. 5	56.49	41.39	27					to	
	9	29. 6	27. 9								E S E	

Sept.

Month.	Day.	Hour.	Altit. of the Thermometer.	Altitude of the Barometer,	Lat. by Account.	Longitude from *Lond.* Acc.	Variat of the Compass	Lat. observ. by *Smith's* Quad.	Lat. observ by *Hadley's* Quad.	Latit. observ'd by *Elton's* Quad.	Latit. by a Sextant of *Ward* & *Smith*	Winds.	Remarks.
			° ′	° ′	°	° ′		° ′	° ′	° ′			
		9	29	29·6 5								N E b E	Hard gales with rain and fogs
Sep.	23	12	26 5	29· 5	55·52	36.50	25	55·44	55·47			to	
		9	26	29· 7								N b W	
		9	31	29· 8									
	24	12	27	39· 9	55· 3	31.21	24	55· 1	55· 4			N N W	Fresh gales and rain
		9	26	29· 8									
		9	27. 5	30								N W b N	Hard gales, with squalls and small rain.
	25	12	26	30	53·43	25·59	23					to	
		9	26	30 2								S W b W	
		9	21	30. 2								S W	First part hard gales, middle and latter moderate and hazy.
	26	12	19	30 2	52.38	22.23	22					to	
		9	20	30. 1								S W b S	
		9	21	30								South	Fresh gales and much rain; hazy weather
	27	12	20. 5	31	52.27	20.15	21					to	
		9	24	30. 1								N N E	
		9	25	30. 2									
	28	12	25	30.25	50.30	16.33	20	51	51			N E	Fresh gales, and much rain; hazy weather
		9	24	30 2									
		9	23	30. 3								N E	Fresh gales and hazy, with some rain the first two parts, the latter moderate
	29	12	23	30. 2	50.20	13. 7	19	50.24	50.25			to	
		9	24	30. 2								N b W	

Sept.

30	9	23		30. 2	50.37	11.41	18	50.30	50.35			NW to S by E	Moderate and fair; winds variable.
	12	21. 5		30. 3									
	9	20		30. 2									
Oct. 1	9	22. 5		30. 3	50.35	11.22	18					S S E	Moderate, with a great head-sea from the eastward.
	12	22		30. 2									
	9	22		30. 3									
2	9	22		30. 3	49.40	12.32	18					S E by S	Cloudy, with a great sea from the eastward.
	12	23		30. 2									
	9	22		30									
3	9	22		29	50. 7	11.39	18					SSE to S by E	Hard storm of wind, with a great sea.
	12	22. 5		29									
	9	22. 5		30. 1									
4	9	20		29. 9	50. 3	10.36	17	50. 4				S S W	Moderate gales, with small rain.
	12	20		30. 1									
	9	20		30.25									
5	9	20. 5		30.35	49.38	8.52	16	49.42				S S W to West	Ditto, fair and moderate.
	12	20. 5		30. 3									
	9	20. 5		30. 4									
6	9	22		30. 2	50	7.20	15	50. 5				South Calm SSE	Saw several Ships, sounded 100 fathom. Moderate.
	12	22		30. 1									
	9	22		29. 9									
7	9	22		29. 9	49.39	6.58	15	49.38				S S E W.N W	Two first parts hard gales and heavy squalls, the latter moderate.
	12	21		30									
	9	21		29. 9									

Explanation of the Tables.

The first column contains the month; the second, the day of the month; the third, the hour of the day, beginning at six in the morning to twelve at noon, and nine at night; the fourth column contains observations of the thermometer; the fifth, the height of the mercury in the barometer, where the first number is the height in inches, the second and third numbers mark the tenths and hundredth parts of an inch; the sixth column is the latitude the ship is in by account, every day at noon; the seventh column is the longitude the ship is in every day at noon, by account, from the meridian of *London*, except where otherwise expressed; the eighth column is the variation of the needle; and the next four columns are the latitudes observed at noon by four several new instruments; the first is Mr. *Smith*'s prismatic quadrant; the second, Mr. *Hadley*'s; the third by Mr. *John Elton*; and the fourth by Mr. *Caleb Smith* and Mr. *William Ward*; the next column is the wind for the most part of the 24 hours.

The thermometer Capt. *Middleton* made use of in the voyage was made by Mr. *John Patrick*, as also the barometer: In his thermometer Mr. *Patrick* places o at the top, supposing it to be the heat under the line; and so the figures increase downwards with the increase of cold: Temperate is placed at 25.

Mr. *Smith*'s prismatic quadrant Capt. *Middleton* finds to be of very great use at sea, particularly for the stars, as he experienced several times in his voyage to *Hudson's-Bay*, in the worst of weather, when one can but see the horizon: And his other is of great use, in tolerable smooth water, in foggy and hazy weather, when there is no horizon to be seen, yet have the benefit of the sun.

An experiment to shew that some damps in mines may be occasioned only by the burning of candles under ground, without the addition of any noxious vapour, even when the bottom of the pit has a communication with the external air, unless the external air be forcibly driven in at the said communication or pipe; by Dr. Desaguliers. Phil. Transf. N°. 442. p. 281.

Exp. I. IN a cylindric glass receiver, open at both ends, whose lower end is plunged in water, and upper end covered with a plate with a hole of near an inch bore, a

candle

candle of six in the pound will not burn quite the time of one minute before it goes out.

Exp. 2. A candle will burn almost as long when the receiver is quite covered.

Exp. 3. The receiver having the hole of the plate open, and a pipe at bottom, communicating with the external air, will burn but a little longer than in the first experiment; and if you blow in at the pipe with your mouth, it will go out rather sooner.

Exp. 4. Blow in at the pipe with bellows, and the candle will burn as long as you will.

A chemical experiment (serving to illustrate the phænomenon of the inflammable air, shewn to the Royal Society *by Sir* James Lowther) *by Mr.* John Maud. Phil. Transf. N°. 442. p. 282.

SIR *James Lowther* having made an experiment on some air which he collected out of a coal mine, and brought in bladders close tied by sea to town: Vid. *Phil. Trans.* *N°*. 429. *p.* 109. The effect of which was, that the air, being pressed out of the bladder thro' the small orifice of a tobacco-pipe, would catch fire from a lighted candle, and burn like an inflammable spirit, till it was all consumed.

Upon considering that this was only owing to a great quantity of sulphurous fumes floating in that air, Mr. *Maud* was induced to make an essay, by an artificial mixture, to produce the like effect. It is well known to every one conversant in chemical matters, that most metals emit great quantities of sulphurous fumes, during the effervescence they undergo in their solutions in their respective *menstrua:* Iron, whilst dissolving in oil of vitriol, emits a great quantity of these fumes, which are very inflammable, and not easily to be condensed. These fumes Mr. *Maud* collected into a bladder with the desired success, and having produced before the *Royal Rociety* two bladders of this factitious air, at the same time that Sir *James Lowther* made trial of his, they both exhibited the same phænomena. A more particular account of the preparation made use of is as follows.

Mr. *Maud* took two drachms of oil of vitriol, and mixed it with eight drachms of common water, which he put into a glass with a flat bottom, about ten inches wide, and three inches deep, with a long neck; to this he added two drachms of iron filings: There instantly arose a great heat, with a violent ebullition, and the iron was wrought upon very fast, with a copious exha-

exhalation of fumes. To the end of the neck of the glass he luted a bladder void of air, the neck of the bladder being fastened to a tobacco-pipe; the fumes arising from the dissolving metal soon puffed up the bladder to its full extent, and after that another bladder in the same manner; and thus you may get as many bladders full as you can, whilst the effervescence lasts. Two of these bladders were tried before the *Society*, and exhibited a flame very like that of Sir *James Lowther*'s in the smell, tho' somewhat different in the colour of the flame. After Mr. *Maud* had pressed part of the air out of the bladder, by drawing back the hand, the flame was sucked into the bladder, and all at once set on fire what inflammable air remained; which went off like a gun, with a great explosion.

What is worthy of notice in this experiment is, that all the air, which filled the bladders, was generated *de novo*, as it were, out of the mixture, or else recovered from the body of the metal in an unelastic state.

This experiment will easily explain a very probable cause of earthquakes, vulcano's, and all fiery eruptions from the earth: For, nothing more is requisite than iron, a vitriolic acid and water: Now iron is generally found accompanied with sulphur; and common sulphur may be analysed into an inflammable oil, and an acid liquor like oil of vitriol. This acid, therefore, in the bowels of the earth, by being diluted with a little water, surrounds the iron, and works upon it in the same manner as described above; an effervescence and intestine heat arises; the air, which comes from the mixture, is rarified, and becomes very elastic; its impetus, by how much the more compressed by the incumbent weight of earth, is increased even to an unlimited degree; and at length like gunpowder will remove all obstacles, and exhibit to the spectators above ground the terrible phænomena of earthquakes and eruptions. Sometimes these inflammable fumes, if very much heated, will, as soon as they come to the open air, catch fire; and so produce those fiery eruptions, of which there are so many instances in the world.

An account of the storm, Jan. 8. 1734-5; *by Mr*. Forth. Phil. Trans. N°. 442. p. 285.

AT *Darlington*, 14 miles south from *Durham*, Lat. 54°. 46′, the evening before the 8th of *January*, 1734-5, Mr. *Forth*'s barometer stood at 29 inches, but had been gradually falling for two days. The wind was then south-west, and of the

the second degree of strength; and increased towards midnight a degree more. Most of the day there was snow or sleet.

The 8th in the morning he found his glass fallen to 28 inches, 8 parts, and at four o'clock *p. m.* down to 28 inches, 5 parts; and by 10 in the evening risen again to 28 inches, 45 parts. All this while the wind was in the north-east, with only a moderate gale, tho' attended all day with snow, which at night was 2 inches and $\frac{1}{4}$ deep; and about eight o'clock it began to freeze. As the wind in the southern parts was all that while in the opposite quarter, Mr. *Forth* would have expected an accumulation of the air, and as a consequence thereof, the rising of the barometer at the time of its falling the lowest. Had the storm happened the night before, when in the northern parts the wind was in the same direction, and had afterwards fallen, he would then have imputed the fall to the quick return of the current of air.

In the *December* of the preceding year Mr. *Forth* finds by his register that there fell through his funnel, whose area is just 100 inches, 13lb. 85parts; yet their almost constant intermitting frosts kept it from going off in any considerable quantity at a time.

	Inches.	
Greatest height of the barometer,	30	10
Least ditto,	29	13

Of the bones of animals changed to a red colour by aliment only; by Mr. John Belchier. Phil. Trans. N°. 442. p. 287.

THAT the circulation of the blood is carried on through the bones, is evident from several phænomena observable in surgery: But that it is universally and intimately distributed thro' the most solid and compact substance of the bones (tho' hitherto doubted by some) will appear undeniably from the instances here produced; which are the bones of several hogs, of a different breed, changed to a deep red colour, merely by aliment. And what makes this still more surprising is, that neither the fleshy nor cartilaginous parts suffer the least alteration in colour or taste.

Their diet was bran, after boiling it in a copper with printed callicoes, in order to clean them from a dirty red colour occasioned by an infusion of madder root, made use of to fix the colours printed on the cloth: Some of these colours are made with preparations from iron, others with a mixture from alum and sugar of lead. The parts printed with the

pre-

preparation of iron produce black and purple; those printed with the mixture of alum, red of different degrees, according to the strength of the mixture. The bran after absorbing the red colour discharged from the cloth was mix'd with the common food of the hogs, and produced this effect on their bones.

Upon examining these bones, he observ'd in general the solid parts to be most tinged, and the teeth in particular, except the enamell'd part, which is of a different substance: And upon sawing them through, he found the internal parts equally tinged, except at the ends of the bones, where the substance was more spongy: And in order to discharge the colour, he macerated them in water for many weeks together; boil'd them often, and steep'd them in spirits, but all prov'd ineffectual: nor was the least tincture given to any of the liquids, in which he made experiments.

An Observation of white Liquor like Milk, that appeared instead of Serum, separated from the Blood, after it had stood for some time; by Dr. Alexander Stuart. Phil. Trans. N° 442. p. 289.

ONE *John Wicks*, carver, in *Bromley-street, London*, about 40 years of age, was ill about three weeks by the loss of appetite, and by indigestion, and at last a pain and distention of his stomach, with a low degree of an inflammatory fever; his tongue was dry, rough, and of a rusty brown colour in the middle, with a white soft list on each side; his urine very high coloured, with a large quantity of a slimy pink-colour'd sediment; his stools very yellow, and loose.

After taking away eight ounces of blood, instead of serum there appeared nothing above the *coagulum*, but a white liquor like milk, which was pour'd off to the quantity of four ounces, or thereabouts. At first there was no smell perceptible, but in six days it began to have the smell of rotten eggs. For three weeks longer it stood in a room, where there was a fire for some hours of the day, and in that time it neither alter'd its consistence nor smell.

The patient had eat very little for a week before the Dr first saw him, and only a little of a calf's foot stew'd the night before for supper, and no breakfast that day. He was addicted to drinking of strong pale-malt liquor every day he was in health.

If this be chyle, it is a substance very different from milk, which is apt to turn sour and thick by keeping, and never contracts the putrid smell of rotten eggs, as this did. Whether it be not chyle turn'd putrid and near to purulency, by long circulation in the blood-vessels, but not converted into blood, through some defect in the sanguification, is a question the Dr. doubts cannot be decided without more observations and experience.

The *coagulum* of the blood was cover'd with a sizy pellicle, about the thickness of a shilling: The red part was of a grumous, tender, incoherent consistence.

Tho' the patient was much better in a week's time, the Dr. order'd five ounces of blood to be taken away, to see what change had happen'd; and he found the *coagulum* cover'd with a sizy pellicle to the thickness of half a crown, the red part of a due consistence, the serum clear and without any chyle.

The urine became clear, and he recover'd in about two weeks after the Dr. had first seen him.

An account of what was observ'd upon opening the body of a person who had taken internally several ounces of crude mercury; and of a plumb-stone, lodged in the coats of the rectum; by Dr. Madden. Phil. Trans. N° 442. p. 291.

THE internal use of crude mercury is of late become so frequent, that Dr. *Madden* believes it might hereafter produce some great benefit to mankind, if a careful collection were made of all the extraordinary cases, relating to the good or bad effects of this practice.

In the following case there are circumstances which are not owing to the internal use of mercury; yet there are many others which were undoubtedly occasioned by it.

Dr. *Madden*, with Dr. *Robinson*, and Mr. *Nichols*, surgeon-general, was present at opening the body of a gentleman of note at *Dublin*, who for several years found great difficulty in going to stool. This disorder increased upon him towards the latter end of his life, and he was siezed with a violent distemper, of which Dr. *Madden* could give no description, having never attended him.

In order to procure a passage downward, (which the Dr. supposes was a principal complaint) the patient took, by the advice of a physician, several ounces of crude mercury, at different times, without any relief, and at length he died.

Upon opening the abdomen, which was very much diſtend-ed, there burſt forth a great quantity of wind, tho' the gu and ſtomach were not wounded.

The ſtomach was empty; and upon opening it the in-ner coat was found very much inflam'd from one en to the other. In ſeveral places of the ſmall guts were ob ſerv'd ſome ſcatter'd grains of crude mercury, and alon with them was generally found a black gritty powder, ver like *Æthiops*, mineral which, without doubt, was the me cury chang'd into that conſiſtence.

The *colon* was diſtended at its origin, to twice the thic neſs of an ordinary man's arm about the ſhoulder. Th extraordinary thickneſs extended itſelf about the length 10 or 12 inches; from hence it gradually decreas'd; a where it was attached to the ſtomach, it had not above $\frac{1}{3}$ that ſize.

It was much inflam'd at its origin, and contain'd at leaſt quarts of liquid excrement, in which was obſerved cru mercury, and likewiſe ſome of the black powder mention above.

The *colon*, where it parted from the ſtomach, and div ged towards the left kidney, adher'd about the ſpace of th inches to the *omentum*; and upon ſeparating it, there w found an abſceſs and inflammation, which had communica itſelf to thoſe parts of the *ileum*, that were contiguous to *colon*.

In this place the *colon* had a perforation about $\frac{3}{4}$ of an i in diameters, and four ſmaller perforations, about the of a gooſequill, thro' which ſome excrement had paſſed i the abdomen.

The coats of the *colon*, as it approached the *rectum*, be to grow ſcirrhous, about the ſpace of ſix inches, and capacity became gradually ſmaller.

The valves of the *colon* about this place were of a red colour, and more ſcirrhous than the other parts of the teſtine. The coats of the *colon*, where it was continued the *rectum*, were at leaſt $\frac{1}{2}$ an inch thick, and its capacity above $\frac{1}{4}$ of the natural ſize.

Upon cutting the gut horizontally hereabouts, there was ceiv'd a body which ſtopped the paſſage, and ſeemed t touch almoſt of a cartilaginous conſiſtence. Having open'd gut lengthwiſe, it was found to be no other than 2 of the

pulæ conniventes coli, grown scirrhous, and protruded downwards into the *rectum*.

There was also found a small plumb-stone in this place, quite buried in the *tunica villosa*, making itself a bed between the coats of the *rectum*: It had likewise formed a small *abscess*, which discharged itself into the cavity of the *pelvis*, but had no communication with the cavity of the *rectum*.

A solar Eclipse *observed at* Rome May 3, 1734. N. S. *by the* Abbè de Revillas, *and M.* Celsius. Phil. Trans. N° 442. *p.* 294. *Translated from the* Latin.

THE *Abbè de Rivillas* and M. *Celsius* observ'd this solar eclipse at *Rome* in the palace of Cardinal *De-via*; they took all possible care to determine the true time, both from the appulse of the solar species to the meridian line, and from equal altitudes of the sun, taken several times the same day, and on the day preceeding the eclipse. They moreover observ'd the eclipse with 2 very good telescopes, about 6 *Roman* palms in length: For, the too great altitude of the sun, being almost in the meridian, and some other inconveniencies hinder'd their making use of longer ones: With the one, which transmitted the solar image directly to the eye, armed with a smoak'd glass, they principally observed the beginning and end of the eclipse; and with the other, which exhibited, as usual, the solar species, the intermediate phases. The clouds had like to have cut off all hopes of being able to make such observations; as at sun rise they tinged the southern parts of the horizon, and afterwards almost the whole heavens. But as thinner clouds succeeded thicker ones, tho' they deprived them of the first contact of the planets, and exhibited the first phases somewhat uncertain, and the species, about the end of the eclipse, indented, as it were; yet they allowed accurately to determine the rest of the observations.

Obſervations	True time p. h.	m. ′	″	quantity of obſcuration Dig.	
1	22	22	35	- - - - - - -	The beginning ſeem'd thro' a cloud to have preceded a little.
2		27	1	0 ½	
3		34	0	1	
4		42	6	1 ½	
5	23	0	52	2	
6		3	16	2 - - - - -	Or a little more; and the greateſt obſcuration was thought to be at hand.
7		10	31	2	
8		28	16	1 ½	
9		45	11	0 ½	
10		52	1	0 - - - - -	The end.

From the 4th and 8th obſervations we may gather that the greateſt obſcuration happen'd about 23 h. 5 min.

The Deſcription and Manner of uſing an Inſtrument for meaſuring the Degrees of the expanſion of Metals *by Heat; by Mr.* John Ellicott. Phil. Tranſ. N° 443. p. 297.

A A (Fig 1. Plate VIII.) repreſents a flat plate of braſs, which, for farther ſtrength, is ſcrew'd down to a thick piece of mahogany: Upon this plate are ſcrew'd 3 pieces of braſs, two of which, markt B B, ſerve as ſupports for the flat iron bar C; and which, on account of its uſe, Mr. *Ellicott* calls the *ſtandard bar*. The upper part of the 3d piece of braſs is a circle about 3 inches diameter, divided into 360 equal parts or degrees: Within this circle is a moveable plate, divided likewiſe into 360 parts, and a ſmall ſteel index: The braſs circle in the Fig. is marked D and the moveable plate *d*. Upon the ſtandard bar is laid the bar of metal, E, on which the experiment is to be made. F repreſents a lever 2 inches and ½ in length, faſten'd to an axis, which turns in 2 pieces of braſs ſcrew'd to one of the ſupports, markt B: To the end of this lever is faſten'd a chain, or ſilk line, which, after being wound round a ſmall cylinder, to which the index in the braſs circle D is faſten'd, paſſes over a pulley, and has a weight hung to the end of it: Upon the axis, to which the lever is fixt, is a pulley, ¼ of an inch in diameter, to which a piece of watch chain is faſten'd; the other end of this chain is hook'd to a ſtrong ſpring, markt G, which ſpring bears againſt one end of the metal E. H repreſents a lever exactly of the ſame form and dimenſions with the former; but the chain faſten'd to the pulley on

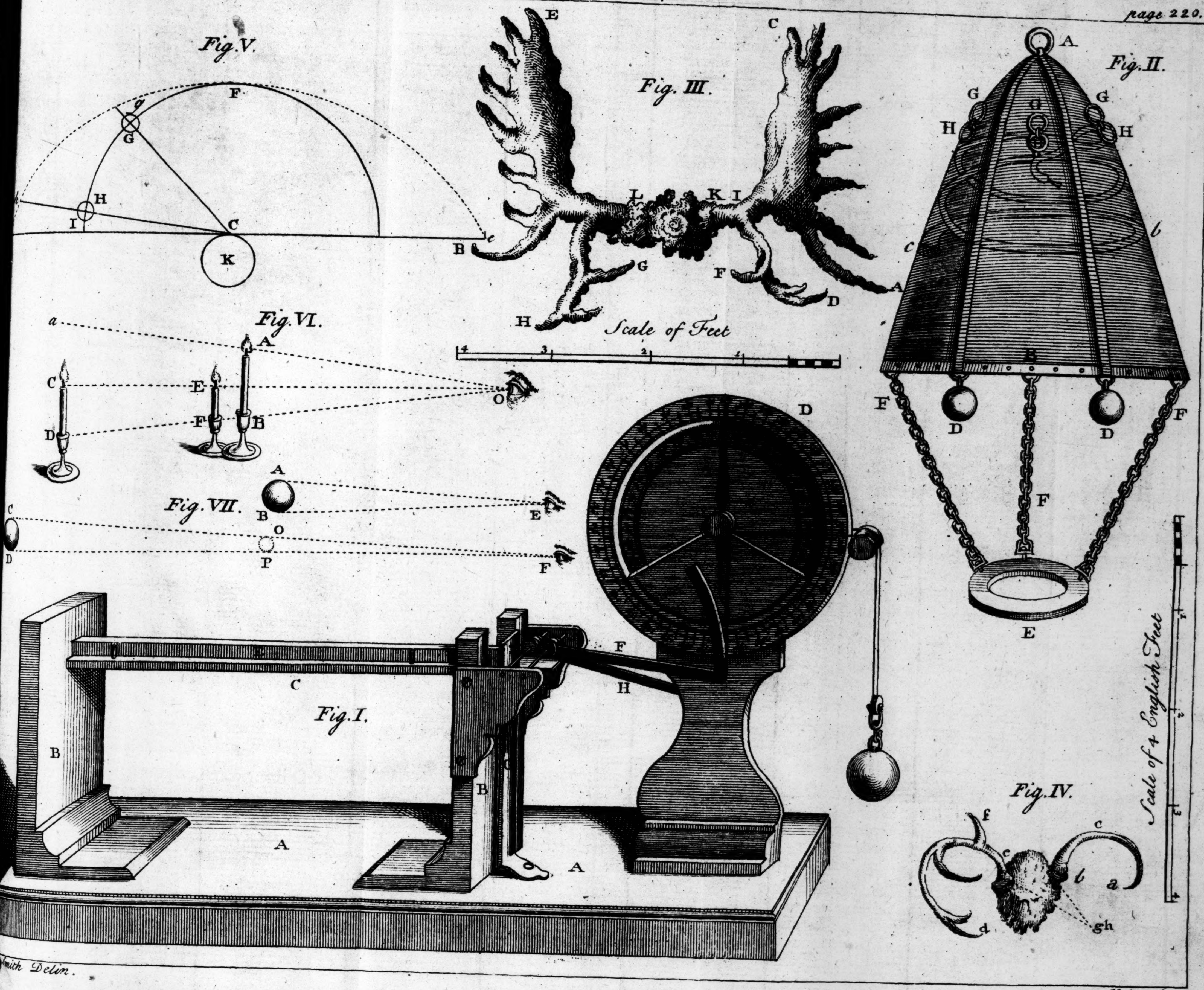

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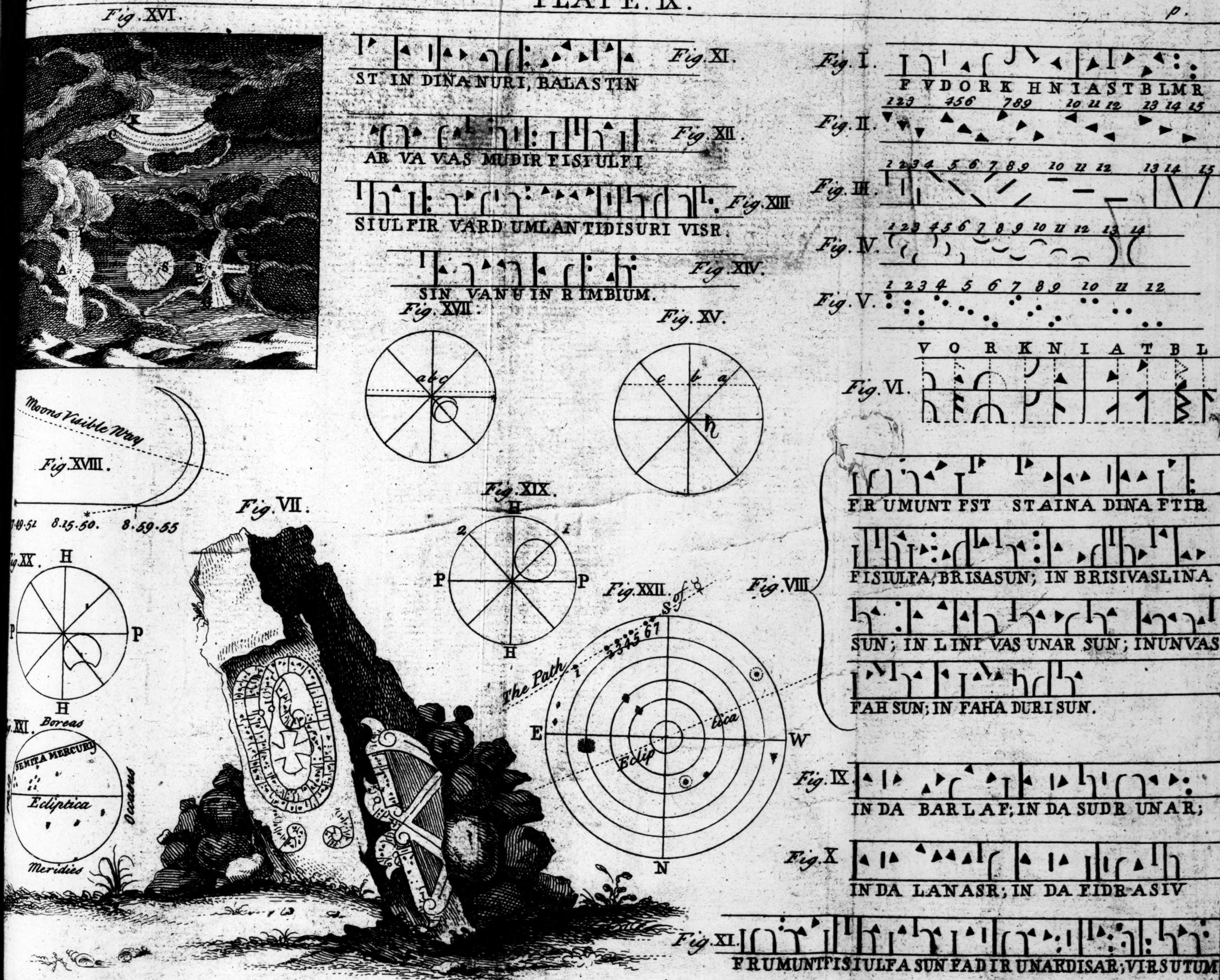
PLATE. IX.



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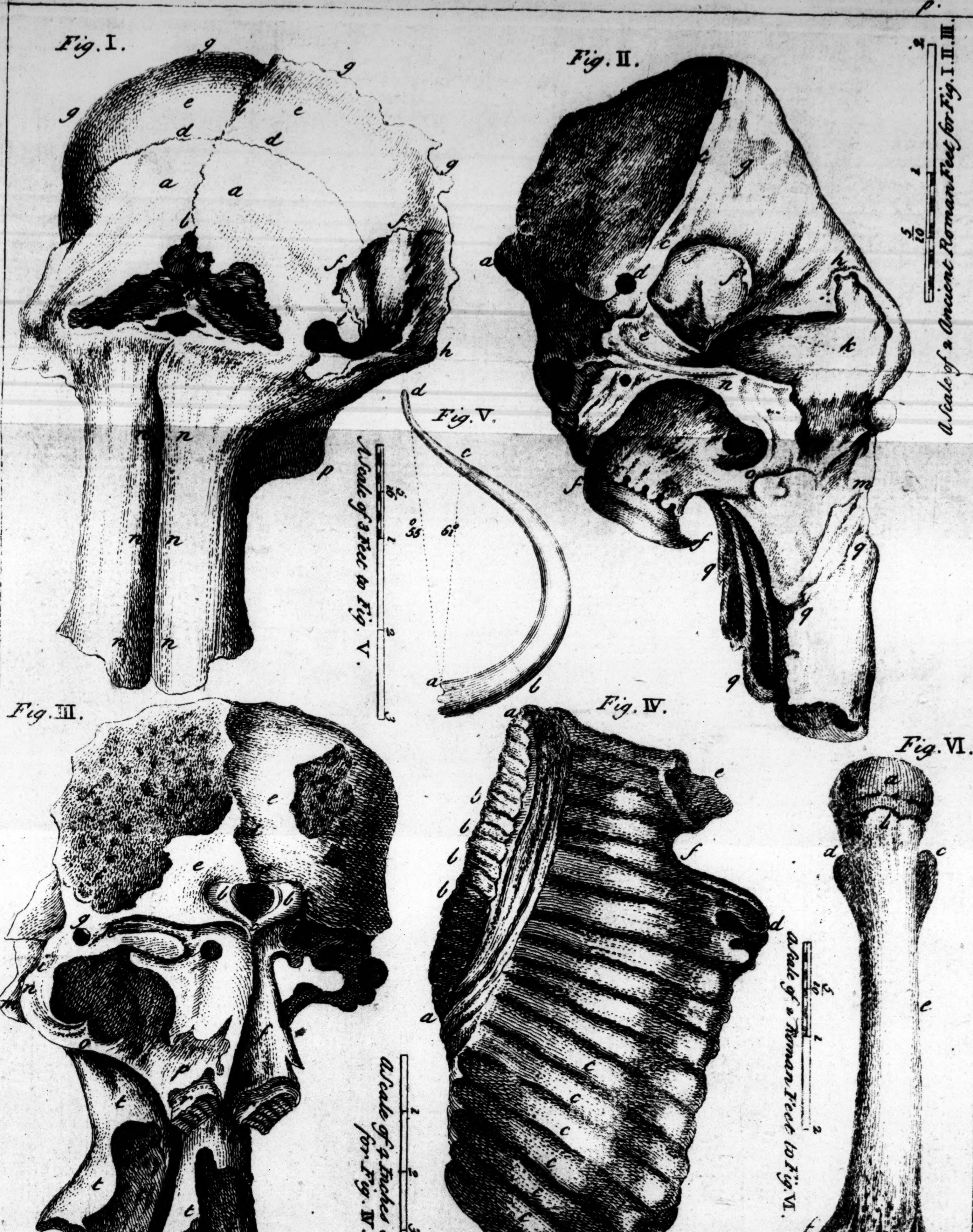
Vol. X. PLATE X. p.



G. Smith del. Hulett Sculp.

n its axis is hook'd to the ſtandard bar. *N. B.* The chain o the former pulley being faſten'd to a ſpring, and not directly o the metal E, is only for the more eaſy ſhifting the metals. The line faſten'd to the end of this lever, after being wound ound a cylinder, to which the moveable plate is fixt, paſſes ver a ſmall pulley, and has a weight hung to the end of it; or ather the ſame line paſſing under a pulley, to which the weight s hung, has its other end faſten'd to the lever F: Thus one veight ſerves for both levers, as in the Fig.

From this deſcription it is plain, that whenever the bar E is engthen'd, it gives liberty to the weight to draw the lever F pwards by its action on the ſpring G; and the index will at he ſame time, by means of the ſilk line, be carried forwards in he circle; and as the bar ſhortens, it will return back again; he ſame motion will be communicated to the ſtandard bar.

Lengthening the bar the $\frac{1}{10}$ of an inch will carry the index nce round the braſs circle, which is divided into 360 degrees; f, therefore, the metal lengthen the 7200th part of an inch, he index will move 1 degree.

To make an experiment with this inſtrument, lay a bar of ny kind of metal, as E, on the ſtandard-bar; then heat the tandard bar to any degree of heat with a lamp, and mark the egree of its expanſion as markt by the moveable plate: Obſerve alſo the degree of expanſion of the metal E, by the heat ommunicated to it from the ſtandard bar, as markt on the raſs circle by the index: Let the inſtrument ſtand till the whole is thoroughly cold; then removing the bar E, lay a bar f any other metal in its place, and heat the ſtandard-bar to the ame degree of heat as before, which is ſeen by the moveable lates marking the ſame degree of expanſion: Then the index vill ſhew the degree of expanſion of the ſecond metal, as it did f the firſt; and by this means the degrees of expanſion of ifferent metals by the ſame degree of heat may be exactly ſtimated.

A farther Account of the Bones *of* Animals *being made red by aliment only; by Mr.* John Belchier. Phil. Tranſ. N° 443. p. 299.

IN the account, *Phil. Tranſ.* N° 442. p. 286, which Mr. *Belchier* gave of the red bones of the hogs, he mentioned, hat the colour was occaſion'd by mixing with their common ood, bran made uſe of to clean printed callicoes; the colours f which were made, ſome from preparations of iron, as the blacks

blacks and purples; others, from preparations of alum and *Sachar. Saturni*, which produce the red colours; and that madder root was made uſe of to fix theſe colours on the cloth. To which of theſe preparations the colours was owing, he could not then determine. Some were of opinion, that it was entirely owing to the preparations of iron; others, that it was the whole blended together: And in order to clear up this point, Mr. *Belchier* determined to make ſome experiments. The firſt he made was upon a cock, by mixing ſome of the madder-root with fig-duſt, on which they feed. — The cock dying within 16 days after his firſt feeding on the madder, he diſſected him, and examining the bones, to his great ſurpriſe, he found them all over of a red colour: So that from this experiment it appears, that the madder alone cauſes this alteration.

Of the Viper-catchers, *and their remedy for the Bite of a* Viper; *by Dr.* Burton. Phil. Tranſ. N° 443. p. 312.

WILLIAM *Oliver* and his wife call'd upon Dr. *Burton* with their vipers, and either of them offer'd to be bit by any viper, and to ſuffer their arm to ſwell for ſome time; and then by the external application of a common cheap remedy, in a few hours to remove all the ſymptoms. Accordingly the experiment was made in the town-hall at *Windſor*, before Dr. *Derham*, Dr. *Waterland*, and before the phyſicians, apothecaries and ſurgeons of the town and ſeveral other Gentlemen in the neighbourhood. The man was bit in the upper joint of the thumb, and higher up on the ſame arm, by 2 different freſh vipers: His thumb, hand and arm ſoon after ſwell'd much, and all the uſual ſymptoms of a viper bite enſued; he applied the remedy (ſallad oil) with the promis'd ſucceſs.

An Account of Experiments made June 1, 1734. *before ſeveral Members of the* Royal Society *and others, on a* Man, *who ſuffer'd himſelf to be bit by a* Viper, *or common* Adder; *and on other Animals likewiſe bitten by the ſame and other* Vipers: *With ſome Remarks on the Cure of the Bite of a mad* Dog; *by Dr.* Mortimer. Phil. Tranſ. N° 443. p. 313.

WILLIAM *Oliver* and his wife, from *Bath*, who follow the buſineſs of catching and ſelling vipers, offer'd themſelves to be bit by any viper that ſhould be procur'd, truſting to the virtue of a remedy they had lighted on by chance in trying variety of things, when the woman was once accidentally bitten, and the uſual known medicines, even the oil of vipers, had

had no effect in aſſwaging her pain, eſpecially that of her breaſt on the ſame ſide with the hand in which ſhe had receiv'd the wound. This remedy which is only common *oil of olives*, and from its uſe with ſallad, commonly known by the name of *ſallad-oil*, recommends itſelf not only from its efficacy; but likewiſe on account of its being readily come at, when accidents happen.

On the 1ſt of *June*, 1734, in the preſence of a great number of perſons, the ſaid *William Oliver* was bit by an old black viper, or adder, brought by one of the company, upon the wriſt and joint of the thumb of the right hand; ſo that drops of blood came from the wounds. He ſaid that he immediately felt a violent pain and ſhooting from the wounds, both to the top of his thumb and up his arm, even before the viper was looſen'd from his hand: Soon after he felt a pain, like that of burning, trickle up his arm; in a few minutes his eyes began to look red and fiery, and to water much: In leſs than ½ an hour he perceiv'd the venom ſeize his heart with a pricking pain, which was attended with faintneſs and ſhortneſs of breath; whereupon he fell into violent cold ſweats: In a few minutes after this, his belly began to ſwell, with great gripings and pains in his back, which were attended with violent vomitings and purgings. He affirmed, that during the violence of theſe ſymptoms, his ſight was gone twice for ſeveral minutes at a time; but that he could hear all the while. He ſaid, that in his former experiment he had never deferred making uſe of his remedy longer than when he perceived the effects of the venom reaching his heart; but this time, being willing to ſatisfy the company thoroughly, and truſting to the ſpeedy effects of the oil, which had never fail'd him, when uſed in time, he forbore to apply any thing, till he found himſelf exceeding ill, and quite giddy.

About an hour and a quarter after he had been firſt bit, a chaffing diſh of glowing charcoal was brought in, and his arm (the cloaths being ſtript off of it) was held over it as near, as he could bear it, while his wife rubb'd in with her hand the ſallad-oil (which the Dr. had bought by the name of *Lucca* oil, and kept in his pocket, leſt they ſhould privately add any thing to it) turning his arm continually round, as if ſhe would have roaſted it over the coals: He ſaid that the pain ſoon abated, but the ſwelling did not diminiſh much; moſt violent vomitings and purgings ſoon enſued, and his pulſe became ſo low, and ſo often interrupted, that it was thought proper by the phy-

physicians present to give him the following cordial draughts at about ¼ of an hour's interval between each.

1. ℞ *Aq. Lact. Pæon. comp. aa* ℥ iij *Sp. Lavendulæ* ʒ1. *m. pro duobus haustibus.*

2. ℞ *Confect. Raleigh.* ʒ ſs. *Aq. Theriacal.* ℥ ſs. *Sp. C. C. gut. x. m. f. haustus.*

3. R. *Confect. Raleigh. Theriac. Andromach. aa* ʒſs. *Sal. C. C. gr. v. Aq. Theriacal.* ℥ij. *pro duobus haustibus.*

He ſaid he was not ſenſible of any great relief from theſe cordials, but that a glaſs or two of oil olive, drank down, ſeemed to give him ſome eaſe.

Continuing in this dangerous condition, he was put to bed, as ſoon as one could be got ready for him, where his arm was again bathed with his remedy over a pan of charcoal ſet by the bed ſide: But continuing to complain much of his back and belly, the Dr. adviſ'd his wife to rub them likewiſe with ſallad oil, heated in a ladle over the charcoal; which ſhe did accordingly: Whereupon he declared he found immediate eaſe, as tho' by ſome charm; and he had not above two or three reachings to vomit, and ſtools afterwards, but made water plentifully, which was not diſcolour'd: Then he ſoon fell into a ſound ſleep, only was often interrupted by perſons coming to ſee and enquire after him till near 12 o'clock, from which time he ſlept continually to five or ſix next morning, when he awaked and found himſelf very well: But in the afternoon, upon drinking ſome rum and ſtrong beer; ſo as to be almoſt fuddled, the ſwelling returned with much pain and cold ſweats, which abated ſoon, upon bathing the arm as before, and upon wrapping it up in brown paper, ſoaked with oil.

Immediately after the man, two pigeons were bit by the ſame viper, they ſoon ſickened and ſeem'd giddy: Nothing being applied, the one died in about an hour's time, and the other half an hour after: The fleſh of both was turned quite black, as if mortified; the blood was coagulated and look'd black.

On the 3d of *June*, the man's arm remain'd ſwell'd, look'd red, marbled with ſpots of yellow, but felt ſoft; and he had the perfect uſe of it, and even of his fingers, no pain or ſtiffneſs remaining. He then cauſed a ſmall ſpaniel dog to be bit on the noſe by a freſh viper: Some oil was immediately applied hot, and rubbed well in, till all the hair of his noſe was thoroughly wet: The dog did not ſeem very

uneaſy

neasy; his nose only swell'd a little; he eat soon after; his nose was bathed once more that evening; he was found very well next morning; but his nose was bathed again, to make sure of the cure: He continued perfectly well without any symptoms ensuing, and was alive and well a year after.

Another pidgeon was likewise bit under the wing at the same time with the dog, but by a fresh viper; the oil was immediately applied hot, and rubbed well in, and the feathers of the wing were thoroughly wetted with it: The pidgeon did not seem at all disorder'd with the venom, but eat soon after, and was found well the next morning, without any remarkable inflammation or swelling about the part. The hot oil was rubbed in again for two or three days, twice a day, and the bird continued well, which shews the efficacy of this remedy, since so small an animal receives the same quantity of venom by the bite as a larger one, and consequently is more liable to die under it: The viper catchers said, that they had experienced their remedy to take effect on cows, horses, and dogs, 10 hours after being bit: but that for themselvess who are frequently bit in the fields, as they catch the vipers, they always carry a phial of sallad-oil along with them, that as soon as they perceive themselves wounded, they without loss of time bathe the part with it; and if it be the heel, they wet the stocking thoroughly with it; if the finger, which happens oftenest, they pour some of it into that finger of their glove, which they immediately put on again, and thus never feel any farther inconvenience from the accident, not even so much as from the sting of a common bee. It may, perhaps, be found of use for the bite of rattle snakes, and other venomous creatures; especially if we consider that in the fields a man seldom or never receives more than one bite at a time, which doth not infect him with so much venom, as was instill'd into the man's blood, when in these voluntary experiments he suffer'd himself to be bitten twice together, and had likewise been bitten three times, but about a week or 10 days before; some remains of which venom, it is highly reasonable to imagine, might still infect his blood at the time he repeated the experiments; so as to make a fresh quantity of the venom operate with greater violence upon his body, than if he had been quite a fresh man, and never infected with the like poison before; or at least at so great an interval of time, that

his blood might have been intirely free from all remains of ſuch an acrid infection. From theſe experiments is it not reaſonable to imagine, that the oil by itſelf may be as efficacious againſt the ſting of a ſcorpion, as if ſcorpions were infuſed in it ?

And now a remedy againſt the bite of the viper is as publickly known as the famous *Dampier*'s powder againſt the bite of a mad dog, which was firſt publiſh'd by Sir *Hans Sloane* in Phil. Tranſ. N° 237, and afterwards by his propoſal to the *Royal College* of phyſicians in *London* in 1720, introduced into the London *Pharmacopœia*, under the name of *pulvis antilyſſus*; the compoſition of which is *lichen cinereus terreſtris*, or aſh-colour'd ground liver-wort and black pepper; the manner of giving it not only to men, but to dogs and cattle, is accurately ſet down in the above-mentioned *Tranſaction*: So that now it is to be hoped, that certain cures are diſcover'd for the only two ſorts of venomous bites of animals, to which the happy ſoil of *Great-Britain* expoſes its inhabitants.

The *lichen cinereus terreſtris* in a letter of Mr. *Oldenburgh*'s, ſecretary of the *Royal Society*, dated *July* 6. 1672, is mentioned as being exceedingly efficacious in curing dogs bitten by mad dogs. Vide *Derham*'s Collection of Philoſophical letters between Mr. *Ray*, and his correſpondents, p. 110, printed at *London* in 1718, 8vo.

Dr. *Mortimer* adds the following paſſage taken out of the journal-book of the *Royal Society*, ſuppoſing it to be what Mr. *Oldenburgh* hints at in his letter.

'*Nov.* 16. 1671. Sir *Robert Moray* exhibited a certain
'plant, (which Mr. *Wray* calls *lichen terreſtris cinereus*) ſaid
'by him to be good to cure dogs bitten by mad dogs: His
'Royal Highneſs having caus'd it to be given to a whole
'kennel of dogs bitten by a mad one, which were all cured
'except one of them, to whom none of it was given.'

The ſpecimen was kept in the repoſitory.

The ſame virtue is likewiſe aſcribed to this plant in the 3d part of *Moriſon*'s *Plantar. Hiſtor. Oxon.* publiſhed at *Oxford* Ann. 1699, in folio, p. 632, where the author ſpeaking of the *lichen terreſtris cinereus*, *Raii Hiſt.* & *Synopſ.* ſays, *adverſus morſum canis rabidi egregium eſt medicamentum.*

Dampier and the *College of Phyſicians*, in their *pulvis Antilyſſus*, preſcribe equal quantities of the *lichen* and pepper. But Dr. *Mead*, in a ſingle quarto leaf publiſhed by him, in

1735

1735, hath alter'd the proportions of the composition, prescribing double the quantity of *lichen* to that of the pepper. This difference in the proportions must be left to the judgment of practitioners: But upon the authority of another minute in the Society's Journal-book, it may not be improper to make an addition to the above-mention'd *Dampier*'s powder.

'*March* 7. 1671-2, Sir *Robert Moray* mentioned, that a 'whole kennel of dogs, belonging to his Royal Highness, 'were bitten by a mad dog, and had been lately cured by a 'certain herb, call'd *stellaria*, or *star of the earth*.'

This plant is the *lychnis viscosa, flore muscoso Casp. Bauhin.* or *Spanish catch-fly*. Vide *Phil. Trans.* N° 187, where is a receipt to cure mad dogs, *&c.* wherein this plant is a principal ingredient; which receipt, communicated by Sir *Robert Gourdon*, was there published by his Majesty's special Command, *Ann.* 1687.

Wherefore suppose the composition were to be thus.

Take ash-colour'd ground liver-wort, black pepper, and the herb *Spanish catch-fly*, all finely powder'd, of each two drachms for four doses, to be taken as *Dampier* prescribes in *Phil. Trans.* N° 237.

Dr. *Mortimer* only adds a proposal of his own, which he made in his *Thes. Inaugur. de ingressu humorum in corpus humanum*, Lugd. Bat. 1724. namely, that the use of the hot bath for persons bit by a mad dog, or hot fomentations, might be of greater service than cold applications: For, a cold bath shuts the pores, as a warm one opens them; therefore, the blood being allowed to be greatly inflam'd in this case; and *Dampier*'s powder being a very hot medicine, it is reasonable to think, that when a patient takes it, the setting him up to the chin in hot water for some hours, would help the operation of the powders, by diluting the blood, and relaxing the pores.

Of an inguinal Rupture, with a Pin in the Appendix Cœci *incrustated with stone; and some Observations on Wounds in the Guts; by Mr.* Claudius Amyand. Phil. Trans. N° 443. p. 329.

Octob. 8. 1735. A Boy, 11 years of age, was admitted into St. *George's Hospital*, near *Hyde-Park-corner*, for the cure of a *hernia scrotalis*, which he had from his infancy, and a *fistula* between the *scrotum* and thigh

terminating into it, which, for a month before, had dis-charg'd a great quantity of an unkindly matter: The rupture was ſmall, and not troubleſome, and part of it could be replaced; but as it appear'd that the ſinuous ulcer ſprung from that part that could not; ſo it was evident that the cure of the *fiſtula* depended upon the cure of the *hernia*, which latter could be obtain'd by no other operation than that for the *bubonocele*, which was accordingly performed the 6th of *December* following.

This operation prov'd the moſt complicated and perplexing Mr. *Amyand* ever met with, ſeveral unlook'd for oddities and events concurring to make it as intricate, as it prov'd laborious and difficult.

This tumour, principally compos'd of the *omentum*, was about the bigneſs of a ſmall pippin: In it was found the appendix *cœci*, perforarated by a pin, incruſtated with ſtone towards the head, the point of which having perforated that gut, gave way to a diſcharge of fæces through the fiſtulous opening therein, as the portion of the pin, obturating the aperture in it, ſhifted its ſituation. The abſceſs, formed in the hernial bag occaſionally, and the ſuppuration for the two months before from this place externally, had knit and confounded, and embodied together, as it were, the gut and *omentum* with the hernial bag, and theſe with the ſpermatic veſſels, and the teſticle; ſo that it was as difficult to diſtinguiſh them from each other, as it was to ſeparate them without wounding them; this pin, whoſe point was fix'd in the *omentum*, continually ſhifting its ſituation, and occaſioning a diſcharge of *fæces*. The pin frequently lying in the way of the knife, and ſtarting out of the wounded gut as a ſhot out of a gun, the inundation of fæces upon this occaſion, from a gut we could not well diſtinguiſh, were ſo many difficulties in the way. But the greateſt ſtill was what to do with the gut, which all this while was unknown and which we could not come to the knowledge of, till the operation was over: For, this *appendix cœci*, which was the only gut found in the rupture, was ſo contracted, carnous duplicated, and changed in its figure and ſubſtance, that it was impoſſible to determine what kind of gut it was; or to find out that it was only this *appendix* elongated, and in diſguiſe.

Non

None of theſe difficulties were apprehended, when we undertook the operation, in which we proceeded as uſual: The *omentum* lying uppermoſt in the hernial bag was ſeparated from the parts it was connected with, and particularly the gut it was embodied with, and afterwards cut off cloſe to the abdominal muſcles, without any previous ligature, the veſſels in it being ſmall, and the ſubſtance of it more like a ſweat-bread than a caul.

A deal of time was ſpent in this diſſection: We were ſtreightened for room, and greatly diſturbed by the diſcharge of the fæces coming out of the gut, upon every motion the pin, lodged therein, and the *omentum*, ſuffered, upon the ſeparation of theſe from each other. The gut forming a double tube, like a double-jointed ſiphon, continuing in the curve, as it paſſed over the teſticle and ſpermatics, was ſeparated one part from the other and from the adjacent parts, as far as the aperture in the abdominal muſcles, where the unperforated part of it was ſeparated therefrom, and thence ſtretched out and unfolded; which brought to view the aperture made in it by the pin, hitherto concealed, thro' which that part of it, which was incruſtated, had juſt made its way out upon an occaſional preſſure, as a cork out of a bottle. It was the opinion of the phyſicians and ſurgeons preſent, to amputate this gut: To which end a circular ligature was made about the ſound part of it, two inches above the aperture; and this being cut off an inch below the ligature, was replaced in the abdomen, in ſuch a manner that an artificial anus might be made there, if the patient's caſe ſhould require it. Afterwards ſo much of the hernial bag as had been detached from the ſkin, and ſpermatics, &c. was cut off, which, as they appeared in a ſound ſtate, were preſerved in their ſite. The fiſtulous opening adjoining to the thigh, and anſwering to the aperture in the gut, was opened; ſome angles of ſkin in the way were removed; the aperture in the muſcles, which had been enlarged by inciſion, was ſtopped up with a tent; and the reſt of the dreſſings, and the ſituation of the patient, ordered in ſuch a manner, as to remove from the wound all ſuch preſſure from within, as might diſturb the cure.

This was a continued diſſection, attended with danger to parts not well diſtinguiſhed; it laſted near half an hour, and the patient bore it very courageouſly. During the operation the patient vomited plentifully, and had ſeveral ſtools, but was ſoon compoſed by half an ounce of diacodium, and emollient embrocations and fomentations, frequently applied warm on the belly:

belly: He was blooded, and an emollient carminative oily clyster was ordered to be applied in the evening; but as he was easy, and the belly not tense, that was omitted. He was confined to a very spare diet, and his body kept open by clysters injected every second day, when stools were wanted, to prevent straining. When dressed upon the fourth day after the operation, every thing appeared well, and we had good reason to hope for a cure, especially as the discharge by the anus was natural. The tent put into the abdominal aperture was not removed till the eighth. On the tenth the ligature round the *appendix cœci*, where it had been amputated, dropped off, and no fæces followed it; and as it was then plain they had taken the natural course, from that time the wound was treated like an ordinary one, only it was observed to keep a strong and constant pressure over the abdominal aperture, as well to fence against the intrusion of the *viscera* into the wound, as by a strong incarnation and cicatrice, to secure the patient effectually against a rupture. During the time of the cure he was confined to his bed, always kept to spare diet, and ordered never to go to stool but in a bed pan: By these means the wound was compleatly healed up in less than a month, and the patient soon after discharged out of the *Hospital* with a truss, which he was ordered to wear some time, in order to confirm the cure.

That the *appendix cœci* should be the only gut found in this rupture, is a singular case in practice; this was full of *fæces*, and could occasionally be distended with an additional quantity, which upon pressure was returned into the *colon*, with that kind of noise which guts replaced generally give: This had occasioned a diminution of the tumour when compressed, before the operation was performed, as the patient was lying backwards with his head downwards, and an increase of it as he stood erect, when the *fæces* from the *colon* could get into it again.

The patient did not remember when he swallowed the pin which had perforated the gut within the rupture: But as this rupture was, from his infancy, fixed and unreducible; so it is likely the pin had then made its way into the *appendix cœci* prolapsed; and that an inflammation ensuing thereon, had occasioned an adhesion, whereby the increase of the tumour had been checked, and the reduction of the parts, prolapsed thereby, rendered impracticable.

The surgeons who constantly dressed the patient before the operation, did then observe, as they had since, that the humour, discharged formerly at the fistula, had frequently the appear-

ance,

ance, and as they thought, the smell of excrement: So that there is no doubt but the cause of it was the wound made in the gut, by the pin giving way occasionally to such a discharge. The patient also perfectly remembers, that the impostumation or gathering preceding the fistulous discharge was attended with very little pain, or much less than generally attends suppuration; which shews that the extravasation of the *fæces* from the gut into the hernial bag, and the bursting of this bag, were the cause of the fistulous discharge, and the continuance of it outwardly.

As to the pin found in the rupture at the time of the operation, it is observable, that two thirds of it, incrustated with a chalky matter, were confined and concealed within the gut; the other third next the point, had made its way through it; the point of which was so lodged in the *omentum* wherein it was fixed, as to leave a free passage for the excrement from the perforated gut outwardly, whenever the perforation in the gut, upon shifting the position of the inclosed pin, could open, and give a passage for the discharge of the *fæces* this way, which was as often as this conical or pyramidal pin altered its place, or did not exactly obturate the aperture in the *appendix cœci* which it exactly fitted. It has been already observed, that the aperture, made in the gut by the pin, lay concealed, the point being lodged in the *omentum*, lying parallel with the gut, which was here duplicated, where it was secured in such manner, that it seemed almost impossible it could ever make its way out of this place, and its other confinement in the gut, as the aperture was callous, and so resisting, that it was with some violence it was forced out of its confinement through an aperture, fitted for the point only, and so streight, that the explosion upon its coming out was like that of a cork out of a bottle: For, tho' it appeared that the opening had been occasionally enlarged, as the incrustated part of the pin was pressed forward into it; yet it is plain nature's attempts to get rid of it had been fruitless; and might possibly have been so during all the patient's life.

Sir *Hans Sloane* has furnished the curious with instances of bodies incrustated in the guts with stone, and of some making their way out, when there was little probability of it. Daily experience shews how far nature will struggle to free herself; so that it is always most eligible to trust them to her care: This may appear from the difficulties that have attended the cure of this case, which at last did not prove so successful as was at first hoped for: For, the patient having been remiss in wearing his truss,

truss, upon some effort the guts found a way into the groi
again, six months after the healing of the wound. This ca
likewise shews, that the best operation, and the utmost car
are no security against the relapse of a rupture. This is th
third or fourth instance Mr. *Amyand* has met with, of the insu
ficiency of this operation to effectuate a cure of ruptures; an
yet it is plain this is by far more likely to prove effectual, tha
the caustic or any other method cried up for the cure of th
evil. In a growing age, a good spring truss is an effectual re
medy; and in an adult, this should be the ultimate one, tho
it be no more than a palliative cure.

N. B. The *omentum*, and the gut, amputated, with the pi
perforating it, are in the repository of the *Royal Society*.

This observation puts Mr. *Amyand* in mind of two he mad
during the late war in *Flanders*, and of two more in *London*.

Observation 1. Upon opening the body of a soldier, wh
had laboured many years with an inguinal and scrotal rupture
Mr. *Amyand* found in a segment of the *ileum*, an appendix lik
a *cœcum*, about six inches long, arising from that gut, an
nearly of the same diameter with the gut itself, the coats where
were somewhat thinner than those of the *ileum* this *cœcum* di
arise from, whose membranes and dimensions were natural. Th
elongation of a segment of the *ileum* appeared, as if it ha
been lodged in the rupture bag it lay near to, and into which
had been stretched along the *vagina* of the spermatic vesse
down to the testicle, according to the expansion of the ruptu
bag, which was of the same dimension: This production of th
ileum, or appendix *ilei*, was full of *fæces*, somewhat narrowe
at its origin or opening into the *ileum* than elsewhere, but nea
ly resembling it, and as sound as that gut it sprung from.

Obs. 2. A soldier having been shot through the belly, th
ball was cut out upon the posterior part of the *os ilium*: F
several months after the *fæces* were chiefly discharged throug
both wounds; and at dressings a great number of flat worm
dead or alive, were found upon the plaister. In five or f
months after, the *fæces* having by degrees taken their cour
thro' the anus, the two wounds being healed up, the patie
returned to his duty as a soldier.

Eight years after this, Mr. *Amyand* had him again under h
care at the hospital, where he was brought with the head of th
os humeri, together with that of the acromion and clavicle,
the articulation with the *scapula*, fractured by a cannon-sho
which thereby was all laid open: The limb was immediate

ut off in the articulation with the *scapula*, having first made a igature about the flesh surrounding the vessels, by thrusting lose to the bone a pack-needle, armed with a strong pack-hread, there being no room for the *tourniquet* (vide M. *Le Dran's Chirurgical Observations*, Vol. II. Obs. 43. 12°. 1731. where he has described the manner of performing the amputaion of the *humerus* in the articulation with the *scapula*) The atient lost very little more blood in the operation, than if a ourniquet had been applied: But the great discharge of matter unk him, and he died the eighth day after.

The death of this patient gave Mr. *Amyand* an opportunity f examining how the former wound in the gut had been ured. He thought the wound had been in the *ileum*, from he thinness of the *fæces* discharged through that wound; but pon dissection he found it had been in the broadest part of the olon. This was very much contracted in that part of it that ad been shot through, where it appeared pursed up, and inseparably connected with the *os ilium*. However, the patient neer complained of any inconveniency therefrom, tho' the narownets of the gut in this place was such, as seemed to make the escent of the *fæces* difficult.

Obs. 3. On the 19th of *January*, 1729, Mr. *Amyand* atended Miss ——, 14 years of age, on account of a suppurated umour on the navel, whose situation was under the *musculi recti*. his patient had had, what is truly called, a starting at the avel in her infancy; and latterly had complained, at times, of swelling there, and likewise of colics, gripes, or vomitings, hat used to go off, particularly as that swelling disappeared. As these grew more troublesome, she latterly had taken a vomit, rom which time she had been greatly costive; and her reachngs, vomitings, and colics, had proved more constant, together with an increasing tension and pain in the forepart of the belly, nd a tenderness at the navel, as matter was gathering there.

Some days before Mr. *Amyand* was called in, Dr. *Campbell* ad made use of the properest methods to remove these comlaints. Upon a consultation, we agreed to discharge by incion the matter collected at the navel, being about a spoonful of ndigested fluid, that had made its way through the *aponeurosis* f the abdominal muscles adjoining to the navel *cicatrice*: Notwithstanding which, the tension of the belly, the costiveness, the eachings and vomitings, rather increasing, as in the *miserere mei*; and having thence reason to apprehend a strangulation nd suppuration of some of the *viscera* in the neighbourhood of

the

the navel, Dr. *Hollings* being call'd in, it was agreed to inlarge the aperture made by the aforementioned matter in the *linea alba*, with a view and intent to know the ſtate the parts were in, to reduce what we found there, or at leaſt to procure a more free diſcharge to the matter collected under the *aponeuroſis* of the muſcles: For a fortnight and more, every thing was done that could internally or externally eaſe the diſcharge, and open the paſſage for the *fæces* downwards, but all in vain. The patient was a whole fortnight without a ſtool, all the ſymptoms daily increaſing, tho' towards the latter end ſhe vomited rather more ſeldom: Yet as ſhe was ſtill taking in, ſo the dimenſions of her belly increas'd in proportion; and the more for that the air confined and rarefied in the *fæces* pent in, added daily to the tenſion; which at laſt had ſtretch'd the ſkin to the utmoſt. There was alſo a ſuppreſſion of urine, the *fundus* of the bladder being ſtretch'd towards the navel, at the ſame time that the neck of it was compreſſed by the *fæces* bearing down in the *pelvis*, and a tumour ſprung up about the *anus*, as if they had been ſeeking a paſſage that way. It was propos'd to ſcoop them out; but the *rectum* was found empty, and the obſtruction was as far beyond the reach of any chirurgical operation, as it had prov'd againſt all the means hitherto employ'd.

The patient was now reduced to the loweſt ebb. The dejections were excrementitious, her pulſe depreſs'd and extremely weak; ſhe had rigors, clammy ſweats, and all the ſymptoms that denote an approaching death, from a mortification in the guts, when of a ſudden the *fæces* burſted the gut, and forcing their way thro' the inciſion at the navel, a quantity equal to 2 or 3 quarts, mixed with various kinds of fruits and ſeeds, which ſhe had been taking during her illneſs, flow'd out like a torrent, with a ſurpriſing roaring noiſe, which gave her immediate relief. The diſcharge continued very great all that day, but the aperture in the hernial bag did not anſwer to that in the gut; ſo that the diſcharge there was at times checked by ſubſtances obturating it; this aperture, therefore, was enlarged by inciſion; and thereby the patient was releas'd from the violence of the vomiting and hickup. From this time we began to entertain ſome hopes of a cure: For, tho' the patient was extremely reduced, and the diſcharge continued exceeding great during ſeveral days, with a *ſingultus* and vomitings; yet ſhe was refreſh'd with ſleep, and was able to retain ſome nouriſhment. The tenſion of the belly ſubſiſted, tho' in a leſſer degree, till the *fæces* had made their way downwards; and ſo did the

vomit-

vomitings at times, as long as the inflammation continued. The diet was ſuch as the caſe required; clyſters were frequently applied, as well as fomentations, and every thing elſe that could determine or invite the diſcharge thro' the *anus*, and reſtore the diſtended guts to their tone: But from the time the *fæces* burſted the gut, it was 12 days before any took the natural courſe; and then matters were brought to the brink of ruin: For, they then pour'd down ſo faſt for a day or two, that the patient was like to have ſunk under them: However, this ſevere evacuation was timely conquer'd by abſorbents and diluents: It took off the remaining tenſion of the belly and all vomitings: And as from this time the *fæces* had a free diſcharge the natural way, and the diſcharge thro' the wound decreas'd in proportion; ſo the wound in the gut, and the external wound in the integuments, were heal'd up in about 3 weeks, in ſuch manner that the patient has ever ſince enjoy'd a moſt perfect ſtate of health.

Obſ. 4. It happen'd that Mr. *Amyand* was not a mere ſtranger to the principal circumſtances of this caſe, as in 1716 he had with Mr. *Laſage*, ſurgeon, attended ſuch another, *viz.* a girl about 4 years of age, in whom the ſame cauſe had produced the like effects, For, upon a ſuppuration of the *omentum*, ſtrangulated in the navel of this patient, the *fæces* detain'd in the neighbouring gut had in like manner forced their way thro' the navel: The accident previous to the burſting and ſubſequent upon it, having been nearly the ſame as in the preceeding obſervation; only the cure prov'd ſomewhat more tedious: For, the wound was kept open by curran-ſeeds frequently working their way out at the navel for about 12 months after, when it was made complete: So that the hardſhips the patient has undergone ſince in child-bearing, and ſeveral hazardous labours, have not been able to diſturb it.

Hence it appears, that the parts inflamed and in contact have coaleſced and knit together; ſo as to prevent any extravaſation from the wounded or burſt gut into the cavity of the *abdomen*.

That the cure in the 2 laſt caſes has been owing to a free diſcharge of the *fæces* thro' the wound; and conſequently, that when in a gut-rupture, the part prolapſed cannot be reduced, a cure may be hoped for by making ſuch an opening in the guts, before they are quite ſphacelated, as may procure a free diſcharge to the *fæces* pent in, and thereby ſecure the patient's life.

That if this happen to the *colon* or *cœcum*, the tube of it will be ſo far preſerv'd, as to open a free diſcharge for the *fæces* the natural way; and if that cannot be obtain'd in a wound of the

ſmall gut; yet the diſcharge may be ſecur'd by making th wound an artificial *anus*.

That the readieſt way to obtain a cure of a wounded o burſted gut, is to keep it in contact with the external wound and the patient at a very low diet.

That the deligation of the veſſels of the *omentum*, previous t amputation, being liable to ſeveral exceptions, it is more eligi ble to forbear it, ſaving when the veſſels are large: For, whe reduced looſe and floating, it is leſs liable to the inflammation and ſuppurations that attend the ſeparation of the ligature.

A Continuation of the Experiments on Mercury; *by Dr.* Boer haave. Phil. Tranſ. N° 443. p. 343. *Tranſlated fro the* Latin.

BY the obſervations made on quickſilver *Phil. Tran* N° 430. p. 145. it appears, that tho' it ſeem continuall to change into other bodies, it ſurpriſingly retains its peculi property, whereby it is immutable.

Dr. *Boerhaave*'s ſole deſign at that time was to give a faithf and accurate account of the proceſſes he had made on mercur and the effects produced therefrom; in order to ſave others t trouble and expence of repeating them.

In the *Memoirs of the Royal Academy of Sciences at Par* for 1734, the Dr. publiſhes farther experiments on the ſam ſubject: And by comparing both theſe diſſertations togethe we ſhall be enabled to form a judgment of the fidelity a minute accuracy of the ancient and genuine alchemiſts, as what they may have ſaid of mercury; and at the ſame tim ſee, that great care and prudence are neceſſary to expla their meaning, or paſs a juſt critic upon them: And he al hopes to put the ſtudious of chemiſtry upon their guar againſt the vague doctrine of modern alchemiſts, which co tains nothing valuable or ſolid, and who themſelves a maſters of no other art than that whereby they would che thoſe of real gold, whom they would perſuade that they c inſtruct in the true method of making it: What the Dr. h formerly demonſtrated of the immutability, ſimplicity a peculiar properties of mercury, he now comes to confirm,

1. Pure mercury, ſuch as is commonly ſold by the co pany at *Amſterdam*, digeſted for ſome time over the fire, d not change into metal.

Proceſs. Upon diſtilling this mercury, it left no dreg b hind; mixing it afterwards with diſtill'd vinegar and ſea ſa

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and shaking it for some time, it continu'd pure. Straining it thro' leather, and pouring a pound of it into a tall clean body, whose mouth was stopt with a paper cone, which was again covered with another paper, fastened well to the neck of the body, that no dust might enter, but the air pass and repass freely; he committed it to a constant degree of heat, which by M. *Fahrenheit*'s thermometer was kept up from the 15th of *November*, 1718, till the 23d of *May*, 1734 above the 100th degree; and he found the mercury in a fluid state, with a small quantity of a black powder on its surface; and grinding this powder in a mortar, it revived into mercury. He put this whole quantity of mercury into a clean glass retort in order to distill it; and heightning the fire towards the end, till the retort became almost ignited, there remain'd nothing at all in the retort; for, the mercury came over without any sensible alteration.

Corollaries. 1. Fire, heighten'd to the degree and continu'd for the time above-mentioned, causes no alteration in the fluidity, volatility or nature of mercury, put into a vessel, where the air has free access to it: nor is there any separation made of the pure from the impure.

2. Nor any sensible generation of metal in the smallest quantity.

3. Much less of gold or silver.

4. None of the mercury was by this process fixt, tho' continued for 15 years and ½; nor was there the least appearance of a beginning metallic fixation, nay not of lead; which, according to those who value themselves upon knowing these things best, is the first metal that should be formed from this process.

5. This process does in no manner favour the opinion of such as affirm, that metals are formed from mercury, as the matter, and from fire, as the fixing sulphur united together by digestion.

6. It seems entirely probable that all such processes, made with common genuine quicksilver, do nowise tally with what authors promise about them; since that small quantity of black powder, above-mention'd, is lighter than the mercury on whose surface it floats, and very easily becomes mercury again: The reader may see in *Phil. Trans.* N° 430 what has been said on the like kind of black powder, produced by shaking only.

7. It

7. It does not appear, that mercury in the mines can be changed into any metallic matter by the sole action of the subterraneous heat acting for some time, and in a place where the air has free access; for, the heat, in places where metallic veins are found, seldom exceeds the 70th degree. They say, indeed, that 1000 years are requisite to produce this effect; but how could mortals, who are so short liv'd, have known this with certainty.

8. As to sulphur, which the alchemists have taken for one of the principles of metals, and of which they say, that it unites the elements of mercury, that it may become a solid body and fixt in such a degree of fire as may fuse and render it malleable: This sulphur seems to differ entirely from that matter of light or fire; tho' fire alone be the only instrument of producing this surprising union between sulphur and mercury.

In this process, however, the air had a free admission to the mercury; and perhaps it might be alledged that this is the very thing that hinders the action of the fire; the rather as Alchemists assert, that crude air hinders the sophical coction; and this induced the Doctor to make the following experiment.

9. Mercury put to digest in vessels closely stopped for the time mentioned below, produces no metal.

Process. The Doctor put pure mercury into a conical glass vessel with a flat bottom, such as Assayers make use of to separate gold and silver, and expos'd it to a heat of 100 degrees from the 6th of *December* 1732, till the 8th of *June* 1733, and the vessel, being always closely stopt, suffered no remarkable change; he took six ounces of this mercury, and put them into a vessel like the former, into whose mouth he inserted the neck of an inverted bolthead; without luting the vessels, he expos'd the mercury for four days to a sand heat so intense, that the mercury began to ascend, in order to evaporate all the moisture it might contain: And when there seemed to remain not the least sign of humidity, he luted the junctures exactly. He exposed the mercury to a pretty strong sand heat, whereby it ascended and descended gently: He continued this degree of heat till the 29th of *January* 1734. In the bottom of the vessel he found nothing but fluid mercury strewed lightly over with a light, subtile, black powder, without any thing fix'd or precipitated, tho' the degree of heat was nearer that of boiling water: He afterwards passed this mercury

ury through a clean, dry, paper funnel, whose lower orifice ould scarce pass a hair.

The purest mercury passed thro' this small hole; and on the des and about the hole of the funnel, there remained a small uantity of a black matter, which ground in a mortar, became ercury again. He committed the mercury thus depurated o a sand heat, in a clean glass retort for distillation, and at e last to a fire of suppression: There remained nothing fix'd the bottom of the retort; the mercury appeared somewhat ore fluid than before, but in other respects it was nowise hanged.

Corol. Hence we may conclude the same things as from e preceeding experiment; and if to these we add what has een said *Phil. Trans.* N° 430, it will plainly appear that ercury in its own nature is invariable either by shaking it echanically, or by distilling and digesting it as above deribed. From all which the Doctor concludes, that chymists ay save themselves the needless trouble of repeating these rocesses, whereby they endeavour to fix mercury, or change into some other body; and he advises them to be on their uard against ignorant pretenders.

The Doctor here gives an account of the success of other borious experiments, he made on metals, besides the preeding ones. He labour'd long to discover whether metals n by art be resolv'd into mercury, and into another prinple; a great many authors affirm this so distinctly and in many places of their writings, that the Doctor saw no cause questioning the thing itself: He took it upon the credit these authors; but to be convinced by his own eyes, he ade trial on lead. The celebrated *Joh. Baptista Van Helmont.* *poteſt. medicam.* §. 40, speaks to the following purpose; I found, *says he*, that the crudity of lead was soluble by the unctuousness of fixt salts, and sometimes deleble by fire only; and thus may the parts of the compound be divided, and the crude mercury permitted to run:' His son *Francisus Mercurius van Helmont* in his paradoxical discourses, *London* 1685, 8vo. Part II. § 22. p. 111. speaks as follows: When lead is dissolv'd by alcalis and salts, or oils, which take in the sulphur, and separate it from the body, the lead by this means is changed into a volatile, running mercury, which can no longer endure the fire, as before, but is cold and running like water, and without a metalline form.' *Joachim Becher* affirms the same thing, and promises

mises success to a great many experiments he describes to thi[s] purpose; vide *Collectanea quingentorum experiment.* p. 31[0] —333. The following is a distinct and brief account of wha[t] Dr. *Boerhaave* learned about this matter, after a tedious an[d] long continued process.

Process. As much pure ceruss, as well could, was dissolv'[d] in spirit of nitre, diluted with six times its weight of water[;] this solution he filtred, and it was found exceeding clea[r.] From this liquor, put into a clean glass vessel, and inspis[-]sated by a gentle heat, and afterwards put to stand in [a] cool place, were form'd crystals, 14 ounces of which h[e] took, and ground to a powder in a glass mortar, with a glas[s] pestle. This powder he dissolv'd in the purest rain-water[,] and diluted the solution with thrice its quantity of rain-water; he afterwards pour'd on gently and carefully ano-ther filtred, and very clear solution of sal ammoniac in rai[n-]water: This mixture becomes white like milk, and th[e] lead immediately precipitates, as happens to silver dissolv'[d] in *aqua fortis*, upon the admixture of sal ammoniac. Th[e] powder precipitated to the bottom, which was as white a[s] snow, elixated, and afterwards dried, became very insipi[d,] and weigh'd 18 ounces and ½. He put six ounces of th[is] white and dry powder into a very clean glass urinal and pour'[d] on it, to the height of two inches, a very strong lixivium [of] quick-lime and pot-ash, which he had kept for several yea[rs] in a phial closely stopped; he afterwards cover'd the urin[al] with filtring paper tied fast about its neck, and put it into [a] heat of digestion of 96 degrees, where he left it from the 6[th] of *Frebruary* 1732, till the 13th of *August* following, to tr[y] whether this mixture, exposed to the open air, would b[e] changed by a heat of digestion; he found nothing but [a] white mass, which reduced to a powder, tasted of salt; th[is] he put into a glass retort coated over with a composition [of] loam and sand, and urged it with a naked fire to ignitio[n,] and continued the same degree of heat for three hours[.] There ascended into the neck of the retort a little white soo[t,] but no mercury at all, and at the bottom remained a britt[le] semivitrified matter of a cineritious colour; this he reduc[ed] again into a powder of the same colour, and ground it f[or] some time in a mortar with a lixivium of fix'd alcaline s[alt] and quick-lime, and dried it again by a slow fire; he pour[ed] on fresh alcali, and exposed it from the 18th of *Augu[st]* 1732, till the 15th of *October* 1733 to a heat of 96 degre[es,]

grin[ding]

grinding it daily in a glaſs mortar, which being cover'd over with paper, freely admitted the air: It was then a white, dry, and ſharp powder; which after pouring on the ſame lixivium a ſecond time, and grinding it, was reduced into a paſte; he committed it to a heat of putrefaction, as above, grinding it ſeveral times from the day above mentioned, till the 21ſt of *February*, 1734. Then it was a ſaline, white maſs, and nearer the taſte of ſea ſalt. After it had been ground well elixated, and very ſlowly dried, he found a very inſipid white powder, which he put into a retort, and kept for ſeveral days in the ſtrongeſt fire the luted glaſs could bear. On the 20th of *May* 1734, there came over no mercury; the neck of the retort was tinged with different colours; the friable maſs that remained at the bottom, exhibited likewiſe various colours diſpos'd in layers, and weigh'd five ounces ſix drachms and ½: The powder, into which the maſs was reduced, look'd of the colour of reddiſh aſhes.

Scholium. In this proceſs, 1. The lead became ceruſs penetrated and diſſolv'd by the vapour of vinegar, and reduced to a white calx and afterwards to a fine powder. 2. It was diſſolv'd in diluted ſpirit of nitre; and thus the lead became a very clear, ſweet, colourleſs liquor, in which it was reduced and divided into its minuteſt particles. 3. The diſſolv'd ſal ammoniac poured on it by expelling the ſpirit of nitre, ſubſtituted in its ſtead ſpirit of ſea-ſalt, and intimately uniting with the metallic part of the lead, diſpos'd it as much as poſſible to expedite the ſeparation of the mercury from the metallic part, according to the opinion of thoſe who are ſuppoſed to have writ beſt on theſe matters: For, they principally aſcribe to ſal ammoniac and ſea-ſalt the property of ſeparating mercury from metals. 4. We have ſeen that the calx thus prepar'd, and kept in digeſtion for 7 months with the ſtrongeſt alcali ſhould have render'd the mercury manifeſt, by abſorbing the *ſulphur* of lead: Yet tho' a great degree of fire was applied, it did not yield the leaſt mercury. 5. This maſs being ſtrongly ground for ſome time, and afterwards mix'd with the ſtrongeſt freſh alcali, and digeſted for 14 months, exhibited no ſign of mercury. It was again ground with freſh alcali, and digeſted for five months; ſo that after theſe proceſſes it was ſufficiently expoſed to the action of the alcaline ſalt, to have time to ſeparate the ſulphureous part of the lead, and to have the mercury, freed from its ſulphur by the force of fire, extracted

 from

from this mass. However after all this labour, the strongest degree of fire extracted no mercury.

It therefore appears that what authors have boldly pronounced of the facility of extracting mercury from lead, is not confirmed by experience: For, say these authors, lead is a metal containing a great deal of mercury, which by the resuscitating salts very readily resolves into mercury. The thing is, therefore, more difficult in other metals: Yet authors promise themselves that this can be done pretty easily, and they prescribe methods differing little from that just mentioned, and from which after so much pains the Dr. learn'd that the event was by no means so successful as they promis'd: And the Dr. very much questions, whether the assertions of these authors on this head be sufficiently supported by observations: And he is rather inclined to think that they have given into their own opinion on this matter, than consulted experience. What has been hitherto said will at least serve to save the reader the trouble and expence of repeating these observations, and prevent his easily admitting pretended principles of metallurgy. It were very much to be wish'd that these ingenious and laborious chemists would give us a faithful account of the success of such experiments which frustrated their hopes, and never prescribe us processes, before they have tried them themselves; which would be a saving of time, expence and labour, and chemistry in a short time would obtain a place among the sciences: Otherwise we shall never arrive at truth, which is the sole aim of chemical disquisitions.

3. *Isaac Holland* writes, that mercury may be easily extracted from the salt of lead, made by distill'd vinegar. Dr. *Boerhaave*, having a mind to make trial of the best litharge and distill'd wine vinegar, prepared the concrete juice called *succus saturni*; two ounces of which he calcin'd in an open glass vessel by a gentle fire continued from the 6th of *June* 1734, till the 19th of *July* following: The white powder, got from it, was with a glass pestle ground very fine in a glass mortar. The trituration was very quick, and continued for some time, and at times pouring a lixivium, saturated with a very strong fixt alcaline salt, as much as the water could dissolve; he kept it in the same mortar covered over with paper at a continued heat from the 21st of *July*, to the 27th of *November*. As soon as this powder was dried he took care to pour fresh lixivium to it, and grind it a-

the time. By drying, wetting, and grinding it alternately all that time, he kept it cover'd over with paper at a heat of 90 degrees. On the laſt day of the proceſs he reduc'd this dry and white matter to an impalpable powder, and put this powder into a luted glaſs retort, and expoſed it for four hours to a fire that was carefully heighten'd by little and little, till the retort became ignited. And yet not the leaſt grain of mercury appear'd either in the receiver, or neck of the retort, at the bottom of which was found a very black light maſs like a powder, and of a very acrid, alcaline taſte. On the 28th of *November* he put it on a glaſs diſh in a cellar, where immediately it became moiſt; and there he left it till the 8th of *January* 1735; at which time it was increaſed in bulk, all the ſaline part having run ſpontaneouſly into a liquor, by means of the moiſt air, the metallic part remaining at the bottom under the form of a black powder. The whole was dried at the ſame time both what had run and what had not, and this mixture was found to be very black. He again put it into a glaſs retort, and towards the end he urged it with a fire, which ignited the whole for four hours; and there appeared not the leaſt ſign of mercury, either in the receiver or in the retort, at the bottom of which remained a matter of a cineritious colour and cauſtic taſte like fire, which expoſed to the open air immediately runs into a liquor.

In this proceſs, lead diſſolv'd with pure vinegar, and diſpos'd in ſuch manner as to be intimately penetrated by the ſalt; mixt and ground with a fixt cauſtic, liquid, alcali; expoſed to digeſt; ſet to putrify, brought to a ſtrong fire, and made to run by the moiſture of the air for a philoſophical month: and again ground, dried, and urged with a ſtrong degree of fire yielded no mercury at all.

4. After the Dr. had been aſſured from his own experience, that the ſalts, called *reſuſcitating ſalts*, could not, in the manner deſcrib'd, extract mercury from lead, he had a mind to try, what mercury itſelf could produce in this caſe; eſpecially ſince chemiſts call this fluid, *the water of metals*, in which ſay they, they die, revive, and become more beautiful, than they were before. He therefore pour'd an ounce of lead into a clean iron ladle; and at the ſame time he heated in ſuch another ladle three ounces of pure mercury; he afterwards pour'd the heated mercury to the melted lead; and they were immediately mixt together, and

and formed a solid mass of a silver colour: He ground this mass, and after he had made it soft again, he heated it in a small phial, which he afterwards stopt with a cork, and put in a digesting heat, kept up always to an equable degree, *viz.* 84 degrees, from the 11th of *February*, 1732, till the 10th of *January*, 1735: It became a soft amalgam, yielding like butter to the pestle, immediately growing black upon shaking it, and weighing 4 ounces. The same day he expos'd it in a clean glass retort to a sand heat, and at length to so intense a fire of suppression, that all the sand was ignited for 4 hours; there came over into the receiver 2 ounces 6 drachms and ½ of mercury. The red powder formed by the mercury in distillation at the bottom and neck of the retort, and what little mercury stuck to the neck, and the few globules of pure lead appearing like a powder, weigh'd together 52 grains. In fine, there was at the bottom a solid mass of lead, that weigh'd an ounce, wanting 5 grains, which compensated the weight of those small globules of lead, just mention'd, that appeared like a powder: Whence it is evident, that the whole quantity of lead remain'd, and that 43 grains of mercury were dissipated. Such as have any knowledge of these matters will readily find out the cause of this dissipation in the reasons above-mentioned; especially when they consider that a part of this mercury does in distillation adhere to the surface of a capacious, large receiver; and that the other part does in the form of *nubeculæ*, float on the surface of the water, which must always be pour'd into the receiver.

By this process the Dr. learn'd, that no mercury can be extracted from lead, by a continu'd digestion of both for 3 years, nor by the strongest distillation; nor that mercury by this means can be fixt into lead: For, in distilling the mercury, a small quantity thereof is always changed into a red powder, which is fixed in the fire here made use of; but the weight of the lead always remain'd the same.

5. He made the same process with an amalgam of 3 ounces of mercury and one of good tin; which he expos'd to the same degree of heat for the same time; and afterwards distill'd in the same manner in a glass retort with the same fire: The success was, that from the receiver he had 2 ounces and 4 drachms of mercury: At the bottom of the retort was a powder, one part of which was fine, and consisted of a little fixed mercury; the other, coarser, black, and compos'd of minute particles like tin. Nay, a little mercury still adher'd to the neck of the

retort,

tort, which in all weigh'd 2 drachms and 5 grains. At the bottom was a solid mass of tin weighing 1 ounce 1 drachm and grains: There was a waste of 46 grains, the reasons of which have been already assign'd.

It appears by this process, that mercury cannot be extracted from tin; but 3 drachms with 14 grains (that is, better than a seventh part of mercury) were united with the tin, and so well fixed, that they could not be separated therefrom by a continued fire of 4 hours, whereby the sand was ignited. In *Nov. lumin. Chem. tractat.* IX. it is said; 'but you cannot be ignorant of 'the great affinity between *Saturn* and *Luna*, in the middle of which is placed *Sol*; as also between *Jupiter* and *Mercury*, in the middle of which is likewise placed *Sol*.'

6. He pour'd 10 ounces of mercury, after heating it well, o 2 ounces of the best tin, melted in a clean iron ladle. He round the whole into an uniform amalgam, which he put very warm and dry into a clean and warm glass bottle, which he fterwards stopt up tight, and put into a wooden box; this he ied to the stamper of a fulling mill, that was continually going lmost day and night from the 30th of *Nov.* 1732, till the 9th f *January*, 1735. Then he took away the bottle, which was ntire, and at the bottom he found running mercury; and after had stood for some days, there was found in the upper part a omewhat hard amalgam; it weigh'd in all 12 ounces: He distill'd 11 ounces, 7 drachms of this amalgam in a luted glass etort with a naked fire, still heighten'd to the end, and till the etort was quite ignited for 2 hours. No greater quantity of ercury came over than was put in, which was very fluid, and the bottom remain'd a mass of tin fixed to the glass, with a ttle dirty matter, foliated, as it were. This mass was fusible, ke tin, in a moderate fire; and then its surface, expos'd to the r, was tinged with various colours. The mass of tin weigh'd ounce, 6 drachms and $\frac{1}{2}$; and there still remain'd a small antity of the dirty matter already mention'd. It is, therefore, rtain, that by a continu'd motion, mercury cannot dissolve tin the manner mercury may be extracted by distillation by the tensest fire.

Scholium. What the Dr. observed remarkable in these 3 t processes was, that the mercury, separated by distillation m lead or tin, was exceeding liquid; and that by shaking it a clean white glazed earthen dish, it would in a short time in its surface, and there leave an exceeding black spot, closely king to it. As soon as the Dr. had wiped off this spot with clean

clean and very dry paper, there was formed another spot, and immediately at several times others. This made him apt to think, that it was owing to the unctuous part of the metal which in distillation passed with the mercury, and was then se-parated from the surface to which it adher'd. In order to be assured of this, he spread the mercury upon very clean and dry white paper, where it left a slight black tract, wherever it pass'd; the surface of this mercury was otherwise always co-ver'd with a very thin pellicle, that appear'd like fat: There-fore, tho' some particles of other metals may by repeated distil-lations of the mercury be united therewith, it will not follow from hence, that any particles are turned into mercury. He tried the same experiment with lead, that had been shaken in the same manner and for the same time: But when he was tak-ing the bottle from the stamper of the fulling mill it happen'd to break, and the matter being lost, he could not finish th process.

These experiments may serve to throw some more light up the nature of mercury.

A partial Eclipse *of the* Moon *observed at* Wittembe Oct. 2. 1735. N. S. *by M.* Weidler. Phil. Transf. N° 44 p. 359. *Translated from the* Latin.

H.	M.	S.	*a. m.* Europ. time.
0	44	30	The *penumbra* near *Schickardus*.
	59	0	The beginning of the eclipse.
1	1	30	The shadow comes to *Schickardus*: Its ed rough and unequal. A little after, the moon overcast.
1	15	0	*Tycho* entirely immerged. The moon imme ately again overcast.
1	25	30	The obscur'd portion of the moon grows blac nor can the *maculæ* be discern'd thro' the s dow with a 9 foot telescope.
1	30	0	The shadow comes to *Grimaldus*: now the sp are seen thro' the shadow.
1	44	30	The shadow covers *Grimaldus* entirely: Now darkened portion is reddish. And immediat the moon is again overcast.
2	25	30	The shadow receding touches *Lansbergius.* edge is still rough.
2	44	0	The shadow comes to *Gassendus*.
3	11	0	*Tycho* begins to emerge.

H.	M.	S.	
3	36	0	The end of the eclipse above *Snellius*, the sky clear about the moon.

A shock of an Earthquake *felt in* Sussex *on the 25th of* October, 1734; *by the* Duke *of* Richmond. Phil. Trans. N° 444. p. 361.

ON the 25th of *October*, 1734, between 3 and 4 o'clock in the morning, there happen'd an extraordinary earthquake in *Sussex*: And what confirms his Grace in the opinion that there really was an earthquake, is, that almost every body agree in the same description, as to the sensation, the hour of its happening, and the perfect calm that was at that time. His Grace observes that the shock was vastly more felt towards the sea-side as at *Shoreham*, *Tarring*, *Goreing*, *Arundel* and *Havant*. At his Grace's house of *Goodwood*, near 3 miles north of *Chichester*, and about 7 from the sea, it was not so perceivable as at *Chichester*, where it was still less so than by the sea-side. His Grace had not heard that there was the least touch of it felt in any parts of the vale on the north side of the *Downs*, which for the most part run east and west.

A farther Account of the same Earthquake *at* Havant *in* Sussex Oct. 25, 1734; *by Dr.* Edward Bayley. Phil. Trans. N° 444. p. 362.

OCT. 25, 1734, between 3 and 4 o'clock in the morning, an earthquake was felt at *Havant* in *Sussex*: The shock was so considerable, as to be observed by one or other in most houses of the town. The Dr. happen'd to be awake at that time, and he perceiv'd the bed shake under him with a quick tremulous motion, which continu'd about 2 or 3 seconds, and then ceas'd; and after a very short intermission was repeated in the same manner, and lasted about the same space of time, as near as he could guess. He was at first greatly surprised at so unusual a phenomenon; but upon a little recollection, he concluded it must be occasion'd by an earthquake; and he was soon confirmed in his conjecture by the concurrent observations of his neighbours, and afterwards by accounts of the same from several other places; in some of which it seemed to have been more violent than at *Havant*. Several persons in this last place affirm, they not only perceiv'd the shaking of their beds, but also the rocking of their houses, together with a rumbling noise of drawers, and the like moveable goods in their chambers and other

other rooms. A learned and ingenious Gentleman at *Havan*[t] informed the Dr. that the motion of his bed appear'd to him like the tossing of a vessel when it crosses over a wave, the head and feet thereof rising and falling alternately several times; whereas the Dr's seemed rather to rock from side to side: But these contrary motions of the 2 beds are easily accounted for, by considering the different positions of them, his friend's bed standing directly east and west, and the Dr's north and south: For, supposing the undulatory motion, which the earth might have at that time, to be propagated from east to west, the same kind of motion which caus'd his friend's bed to rise up and down lengthways, must make the Dr's rock from side to side; as may be observed in 2 vessels sailing in contrary directions on the same waves of the sea; that which crosses the waves at right angles being tossed up and down end-ways; while the other, moving in a line parallel with the waves, will be rocked from side to side. What makes the Dr. the more inclined to think the progressive motion of this earthquake to have been from east to west, is, because it appears from the best accounts he had of it, that it was observed sooner east than westward, and likewise extended farther from east to west than north and south.

He thinks it may not be amiss to take notice of some remarkable phenomena, which happen'd before and after, as well as some other circumstances, which immediately attended this earthquake; most of them agreeing with those signs, which have been observ'd by the learned to precede or accompany former earthquakes in these and other parts of the world. It is observable, that there was more rain and wind for several months successively, than for many years before; especially from the beginning to the middle of this month, about which time it clear'd up, and the weather became suddenly very cold with frosty mornings, the wind blowing generally pretty hard from N. W. On the 23d of *Oct.* the cold abated considerably; it was cloudy, but no rain that day. The 24th was calm all day; it rain'd most part of the afternoon, tho' the mercury stood at 30 $\frac{2}{10}$. It continued very calm all night, and rain'd hard for some time before and after the earthquake happen'd; but it soon clear'd up, and a strong gale of wind, arose within half an hour, or as some said, within a quarter afterwards: It continued blowing hard all the forenoon. At 4 o'clock in the morning the Dr. observed the mercury continu'd at 30 inches $\frac{2}{10}$: the spirit of wine at 55 $\frac{2}{10}$, having risen about 5 degrees since the late cold weather.

N. B.

N. B. The Dr's barometer and thermometer were both in [o]ne frame, and made by Mr. *Hauksbee*.

The circumſtances related by his Grace the Duke of *Rich*[*m*]*ond* and by Dr. *Bayley* are confirmed by the united teſtimonies [o]f ſeveral perſons of veracity, who ſigned certificates of what [th]ey obſerved concerning this accident at *Chicheſter* and other [p]laces.

Mr. *Boisdune* of the pariſh of *Funtington* in the county of *Suſ*[*s*]*ex* and ſeveral perſons living in the city of *Chicheſter*, all agree [th]at there was a manifeſt ſhock of an earthquake felt on *Oct.* 25 [a]bout a quarter before 4 in the morning, which laſted by fits [so]me few ſeconds, about a quarter of a minute, or while one [m]ight tell 20, with a motion ſenſibly ſlow: For, moſt of the [a]ccounts concur in this particular, namely, that the chairs, [w]ainſcot, doors, cheſts of drawers and other moveables, were [h]eard rattling; and one, that a bell rung of itſelf juſt before [th]ey felt the heaving of their beds; and that there was no wind [ſt]irring at that time, but that it rain'd, and the wind roſe ſoon [a]fter.

Mr. *Green*, prebendary of *Chicheſter*, had informations of the [ſa]me tremblings, attended with the ſame circumſtances, being [fe]lt at *Shoreham*, *Goreing*, *Tarring*, *Findon*, *Arundel-caſtle* [an]d *Merſton*.

John Shaw, *Thomas Dagly*, and *John Towner*, all ſervants [t]o the Duke of *Richmond*, felt the ſame at his ſeat, call'd [G]*oodwood*.

Mr. *Jenkins*, riding officer of the cuſtoms in the pariſh of [W]*eſt-Wittering*, near *Bragleſhambay*, in the county of *Suſſex*, [d]eſcribed the ſhock after the ſame manner: And he farther [a]dds, that within half a quarter of a mile of his houſe, a [y]oung man, about 18 or 20 years of age, having been at the [ſa]me time to fetch up a team of horſes from graſs, the horſes [w]ere ſo ſenſible of ſomething more than ordinary, that they [ſt]amped and ſeem'd very much affrighted, as they were coming [h]ome.

[O]*f a ſhock of an* Earthquake, *felt at* Aynho *in* Northamp[tonſhire] October 10. 1731; *by Mr.* Joſ. Waſſe. *Phil. Tranſ.* N° 444. p. 367.

ABOUT 4 in the morning *Oct.* 10. 1731, Mr. *Waſſe*, Rector of *Aynho* in *Northamptonſhire*, ſays, that his [w]indows rattled, as if ſome body had been dancing over head: [T]he concuſſion laſted about a minute; others thought it laſted

about two minutes: It alarm'd the neighbouring village *Bloxam*, four miles south-west from *Aynho*; *Barford*, five *Banbury* four miles west; *Aderbury*, a mile west: *Crowton* a mile to the east; and *Charleton* as much to the north. There was no notice taken of its progress south or south-east.

About a minute after, some of the town of *Aynho* saw great flash of lightning. In the morning the sky looked of a land colour: It was said that there was a former shock felt *October* 8, about three in the morning; and that the latter was preceded by a noise like distant thunder.

It is remarkable, that this shock at *Aynho* was perceiv'd to extend more from east to west, than from north to south which particular was likewise observ'd in the shock felt in *Sussex*, in 1734.

The sequel of the Experiments on Mercury; *by Dr.* Boerhaave. Phil. Trans. N° 444. p. 368. *Translated from the* Latin.

FROM the observations on mercury, *Phil. Trans.* N° 430, p. 145, and N° 443, p. 343. it appeared, that the nature of mercury is never changed, tho' surprisingly varied in appearance it should often seem to change into new forms. The Dr. now comes to rehearse some other processes he had made; whence a much greater constancy or immutability is evinced, and at the same time the nature of other metals will be shewn. The most ancient Alchemists, and who may justly be reckon'd the best, unanimously agree, that mercury is quick metal: But then at the same time they affirm, that when it is genuine and free of all impurities, it is so simple, as to be entirely the same in all its parts, and incapable of being divided into parts of a various nature. They moreover affirm, that upon that account it is immutable to every cause, and at the same time of so penetrating a nature, as to be able to dissolve all other things; and yet itself remain unchangable: And as they are plainly agreed in these things, so likewise in this, that it is never got pure from its veins, but always tainted with a heterogeneous impurity, which, originally being concreted and hence growing up with it in a surprising manner, is intimately incorporated therewith. They regret that it is with the greatest labour it is freed of that impurity; because in the primeval formation of the seed it is insinuated and almost indissolubly incorporated with its very principles of vegetation; and the imp

impurity they call'd ſulphur; in reſpect of which alone they diſcover'd quick-ſilver mutable; and this alone they blame as what hinders its ſubtile penetrating quality by obtruding the peculiar edge of mercury; and what makes it unite with adventitious matter. But ſhould an ingenious and lucky artiſt by ſome ſecret method free this mercury from all its congenial impurity, it would be no longer changeable, it would acquire a degree of ſubtility, by which it would pervade all other things; would not mix with any thing in nature, but obſtinately retain the ſtricteſt purity. But how ſurpriſing is its nature! It concocts crude metals, perfects the baſer ones, readily attenuates and reſolves all other bodies, and turns them into their radical moiſture; and thus it is juſtly cried up as the chief inſtrument in medical and chemical arcana's. The adepts, it is true, tell us, that it reſembles fire, which remaining unchangeable itſelf, changes every thing elſe: and dividing and uniting every other thing, remains itſelf untouch'd and intirely free.

By ſuch tempting promiſes chemiſts were incited to find out a method of freeing mercury from this impurity, in order to have it pure and ſimple: And the wiſeſt of them thought it was to be burnt out by fire alone; becauſe fire is the ſole purifier of metals: Hence aroſe the diſtillation of mercury in clean cloſe glaſſes; and this ſo often repeated, till the whole was turn'd into a red, ſhining powder. But urging this powder with the ſtrongeſt degree of fire in clean glaſſes, they again recover their priſtine mercury; which they miſtakenly took for purified, ſince by the new action of fire it ſuffers itſelf to be again reduced into a ſimilar red, and ſhining powder. And the greateſt maſters openly deny that quick-ſilver duly purified and defecated by art, can ever by the action of fire be brought into a powder, even if the proceſs be continued to eternity. And here perhaps it may be proper to peruſe what has been ſaid *Phil. Tranſ.* N° 430, about 511 diſtillations of the ſame mercury in glaſs veſſels.

But it is ſcarce credible, that its depuration can be obtain'd by ſuch a method; and poſſibly there was another method of working by which this was to be done: And the chief Maſters in the art do plainly enjoin a different method: For, they ſay that this depuration is procured, while the nucleus of the mercury is detained by the pureſt bodies, which from their near affinity with it, do cloſely and indiſſolubly

lubly unite therewith: But gold and ſilver are pure, fixed metals, and very like genuine mercury, either if we regard their origin or their matter. They hold that it hence follows if mercury be mixt with a perfect metal, and by means of fire be again ſeparated therefrom in glaſs veſſels cloſe ſtopt that the part of the pure metal will take in the mercury, and at the ſame time ſeparate the impure from the pure part: The Dr. had a mind to try what truth was in this aſſertion, by ſetting about a laborious proceſs, the ſucceſs of which was as follows.

The Dr. had at the bank at *Amſterdam* two ounces and ½ of the pureſt gold, that could be procured by Aſſayers art; he divided it into five ſmall maſſes that weigh'd ½ an ounce each He put them all into a clean glaſs retort, and poured 25 ounces of pure mercury that had been once diſtilled before; half the mercury came over from the gold, which lay under it at the bottom of the retort. Having thus finiſhed the proceſs, there came over 13 ounces of mercury into the receiver: At the bottom of the veſſel the gold was now entirely diſſolv'd in the mercury, in the form of a perfect white mixt, call'd an amalgam: Whence it appears, that gold is diſſolv'd by the heat alone of boiling mercury; and this ſeems to be the beſt method of mixing theſe two together, call'd by artiſts *Amalgamating*. After drying well the quickſilver that came over, he return'd it upon the remainder in the retort; and he again brought over by the fire an equal quantity of mercury, which after drying he poured afreſh upon the remainder: And this he repeated 50 times. At laſt there came over pure mercury: In a glaſs mortar he ground with a glaſs peſtle the black amalgam that remain'd at the bottom of the retort, and the water he poured thereon became muddy, he waſh'd it with pure water, which again became muddy upon grinding. This he cauſed to do for 13 days, when the water was no longer muddy, but the amalgam ſhone bright and the water remain'd clear. The powder, prepar'd by grinding and waſhing, which was of a dark colour, and of a horrid metallic taſte, when dried well, weigh'd 83 grains the mercury and gold weigh'd 26 ounces, 7 drachms; there were ſeven grains loſt; three drachms and ½ in 50 proceſſes This happen'd partly by the mercury evaporating, and partly by its adhering to the filtring paper, by which it was dried from the water, into which it was receiv'd in diſtillation.

He

He again treated this pure amalgam in the ſame manner other 50 times: And now the 50th time there came over pure mercury: At the bottom of the veſſel there remained a dark amalgam; which after triture and lotion with water, in the manner above mentioned, for 13 days together, yielded 1 drachm, 44 grains of a clean, dark, dried powder: And then the pure amalgam, together with the mercury, weigh'd 26 ounces, 4 drachms: By theſe 50 operations he loſt 1 drachm, 16 grains.

He again caus'd diſtil for 50 times in the ſame manner this depurated amalgam: And there came over pure mercury; and at the bottom of the retort there was a reddiſh amalgam, which ground and waſhed with water as before, for 14 days, yielded 1 drachm, 11 grains of a dark powder. He added the mercury that came over to the pure amalgam, which together weigh'd 26 ounces, five drachms 24 grains: But while he was pouring off the amalgam, there ſtuck ſome of it to the bottom of the retort; ſo that he could not compute the waſte.

The depurated amalgam again treated 50 times in the ſame manner, as by diſtillation, triture, and lotion for 14 days, yielded a dark powder, that weigh'd one drachm and ½ and four grains. The moſt ſhining amalgam, mixt with the pure mercury that came over, weigh'd together 25 ounces, two drachms, 46 grains after 200 diſtillations.

He urged this amalgam 50 times as before; and afterwards grinding it anew with water for 16 days together, he got two drachms, one ſcruple, and 4 grains of a dark powder; the bright white amalgam, together with the mercury, weigh'd 25 ounces, one drachm, 46 grains.

Having gone through this laborious proceſs he obſerv'd that after 250 diſtillations of mercury with gold, both of them yielded one ounce, five grains, of the above deſcribed powder; that there remained 25 ounces, one drachm, 46 grains of gold and mercury; and that there was loſt, in the manner mentioned, one ounce, two drachms, and 9 grains.

The attentive conſideration of theſe things made him with joy begin to ſuſpect, that he now ſaw the ſo much deſired method of purifying mercury, whoſe impurity probably lay concealed in that powder, which he ſometimes thought to be a mere fetid, dirty ſulphur, that ſtain'd the virgin purity of quickſilver, and he doubted whether now he did not ſee it pure, after having undergone the action of fire and water.

But

But his joy was check'd upon recollecting how often his over-hasty hopes had vanished into smoke: Amidst these doubts he resolv'd not to rest, till he was certainly assur'd of the truth; he, therefore, caus'd distil over again 25 ounces, 1 drachm, 46 grains of that last and purest amalgam, always bringing over half of the mercury, and pouring it on again for 627 several times; and he ceased washing it any longer with water, in order to see the event. By this process the matter usually grew dark, so as at length to be almost black: Then he did over the glass in which it stood with a coating that could bear an open fire; and thus he urged the black amalgam, that was no longer wash'd, with so intense a fire, as that in 3 hours time the retort was entirely ignited; and there came over 20 ounces of the purest mercury; and afterwards breaking the vessel he found at the bottom 2 ounces and ½ of the brighest gold, without leaving any dreg at all behind.

He afterwards took 7 drachms, 57 grains of the powder of 250 distillations; and urged it with a very intense, open fire in a retort coated over, so as to ignite for some time: From this powder were recovered 7 drachms, 46 grains of the purest mercury; at the bottom of the retort remain'd, as he found 6 grains of a dark powder.

Upon weighing hydrostatically the quicksilver urged in this manner 877 times, he found it to pure water, as 13 and ½ to 1; so that its density was not changed, notwithstanding it underwent such a variety of operations, nor was it freed of any of its lighter parts. As the Dr. understood that his method of finding out the weights, mention'd *Phil. Trans.* N° 430. was suspected not to be sufficiently accurate, he now adds what follows from what was said above.

1. Gold dissolved by mercury, by repeated coction and trituture, changed nothing of its pristine nature, lost nothing of its proper weight, and acquir'd nothing, as far as could be gather'd from the foregoing experiments.

2. Quicksilver, mixt with gold, and again separated from it by fire, has part of it turned into a dark, subtile, powder, of a horrid metallic, taste, and of a quite different nature from what it was before; and this always happens till 877 times; yet it again returns, by a stronger degree of fire alone, to the same quicksilver it was before, with every quality observable by art.

3. Fire therefore and gold do not by this means separate from quicksilver different parts, as sulphur, dregs, or any other thing

thing; but only change it in outward appearance, which is again recoverable, and ſo entirely the ſame, that its proper weight is in nowiſe changed.

4. Quickſilver and gold by the force of fire do immediately change the ſilver brightneſs of their amalgam into a dark and at length a black colour: But the reſtoring the ſilver brightneſs to the mercury, and the yellow brightneſs to the gold by a ſtronger degree of fire alone, ſhews that this colour does not infer any corruption or real change in the nature of the metals.

5. Yet if native mercury can poſſibly be depurated by gold and fire, according to the opinion of the ancients, this muſt be perform'd by ſome other proceſs.

6. The hopes of fixing mercury with gold by the action of fire prove all abortive: Since after ſo much labour and length of time, there is not even a beginning towards it; the laſt diſtillation was performed as eaſily as the firſt.

7. Hence we have no confirmation of the opinion, that fire can concrete to metals or to mercury to the increaſe or generation of ſomething metallic; or to the fixt ſtable change of the metal itſelf.

8. Great then is the conſtancy and ſimplicity of quickſilver and gold! If gold were originally quickſilver; is it not then truly ſaid, that mercury either entirely evaporates in the fire, or remains entirely fixed therein.

9. The big promiſes of 2 great men in the profeſſion about the diſſolving of gold by triture, either with or without water, prove all vain: They declin'd the troubleſome taſk, and were over haſty in making concluſions.

There remain'd one thing worth enquiry; whether mercury, diſtill'd ſo often from gold by the force of fire, had not depoſited that property, by which it is turned by diſtillation into the powder, call'd precipitate *per ſe*? He, therefore, caus'd diſtil in a clean glaſs retort theſe 20 ounces of quickſilver, diſtill'd 877 times from gold, and that with ſo ſtrong a fire, that no mercury at all remain'd in the retort after each diſtillation, and this he repeated 8 times. At the bottom of the retort he had 12 grains of a ruddy, ſparkling, ponderous, mercurial precipitate, of a horrid metallic taſte. The Dr. therefore was aſſur'd, that even this quality is not taken from the mercury by this laborious proceſs.

An

An improvement of the Diving Bell; *by M.* Triewald. Phil Tranſ. N° 444. p. 377.

M. *Triewald* having made trials with the diving bell and air barrels in ſeveral depths on the coaſt of the *Baltic* according to the ingenious improvement of Dr. *Halley*, made in 1716, but with ſome ſmall additions, found by experience that no invention built upon any other principles than thoſe of the *campana urinatoria*, can be of uſe in any conſiderable depths; or that the diver in any other invention whatever, can be a ſingle moment ſafe. As to the many inconveniencies that attend other inventions, he only mentions that of a water armour, in which the man is drowned in an inſtant, when ſuch a machine receives the leaſt leak: Whereas experience has ſhewn that the danger is not ſo great when ſuch an accident happens to the diving bell; as to his knowledge it did once, when the diver was 12 fathom under water, and a pretty large hole was ſtruck into the bell, by a boult of the wreck he went upon, when the air ruſh'd out of the ſame with ſuch violence as aſtoniſh'd the beholders by the exceſſive boiling on the ſurface of the water, but the man in the bell clapp'd his hand to the hole or leak, and gave a ſignal to be haul'd up; which was done with all the eaſe and ſafety, as if no ſuch accident had happen'd, the water having only riſen about half a foot into the bell by this leak.

This ſame man had a worſe accident befal him at another time, by the bell's ruſhing down at once about a fathom or more, by the careleſsneſs of thoſe that worked it; the blood guſhing out of his noſe and ears, he felt an intolerable preſſure on his whole body; which ſhews, that when a man in a diving bell is ſlowly and gradually let down, he at ſuch a time and by degrees reſpiring compreſs'd air, which by the lungs is forced into the blood, cannot feel the external preſſure of highly compreſs'd air, nor of the water reaching ſome parts of his body; a conveniency no other invention can afford, where the diver is to draw his breath from air in its natural ſtate.

M. *Triewald* has often with pleaſure obſerv'd, that when he has caus'd the bell to ſtop, at 5 fathom depth, and the diver taking in the air contain'd in an air barrel, lower'd down a fathom deeper than the bell, without opening the cock for diſcharging the hot air; the water would, by the acceſs of the air out of the barrel, be entirely, or to a very ſmall matter expell'd out of the bell; and when the ſame was again lower'd

down

down 5 fathom more, the same operation with another air barrel repeated, and the bell afterwards haul'd up, it was no small matter of delight to observe, that every fathom the bell came up, it would discharge itself of the superfluous air in a large quantity, which came up from the bottom of the bell, in bubbles, as big as ostrich eggs; and thus discharge of air continu'd, til the equilibrium of the air in the bell, and pressure of the water, were restor'd, and till the bell came above the surface of the water.

At other times he observed, when no air was by the way taken into the bell, but the same lower'd down the common way, and haul'd up again after some time, that the very instant when the bell should part with the surface of the water, the strength of two men more was requir'd at the capstan at that time, than before and after the bell hung freely in the air: From whence he presumes it plainly appears, that the air, which passes thro' the lungs of a living creature, loses its elasticity; and that the lungs of a man make a kind of a *vacuum* in the bell; for which reason the diver feels at the very instant, when the bell parts with the water, a very smart pressure in his ears.

Tho' experience has thus taught, that no invention is more safe and useful than the *campana urinatoria*, with the ingenious improvements of Dr. *Halley*; yet M. *Triewald* has likewise found, that this invention is not to be made use of without considerable charge; it requiring a large vessel, and number of hands, to work and manage such a large diving bell, together with the air barrels and their respective weights for sinking: That the expences therefore might be lessen'd; and that the diving bell, nevertheless might answer all the intents and purposes of Dr. *Halley*'s, M. *Triewald* has made the following improvement on it.

The diving bell AB (Fig. 2. Plate VIII.) M. *Triewald* caus'd to be made of copper, and he reduced the same to a very small compass in regard to Dr. *Halley*'s, as may be seen by the scale under the draught; by which means it is easily managed by 2 hands: Yet he presumes that a diver may live in the same for as long a time, and with as much ease, at a very considerable depth of water, as in a bell of twice its capacity; because that tho' a man in a large bell has undoubtedly more air than in a less; and consequently, should be able to subsist a great while longer on a large than on a small quantity of air; yet since his head is generally in the upper part of the bell, where the hot air takes up its residence, he receives very little or no

benefit of the air under his chin or breaſt, tho' never ſo fit for reſpiration; which air, nevertheleſs, in the lower parts of the bell will remain cool a long time after he has been in the bell and has with difficulty drawn his breath; as is very obvious to any one who has been in a *German* Bagnio, and ſuch as are uſed in *Sweden*; where in a ſingle room all the degrees of heat are to be felt, by means of a contrivance like ſtairs to the very top of the cieling: A man, when he places himſelf on the uppermoſt ſtep, will feel an exceſſive heat; ſo that any body not very much us'd to it cannot endure the ſame, nor draw his breath, but faint away: Whereas on the firſt, ſecond, and third ſteps from the floor, the heat is very moderate; nay, ſometimes the air near the floor is pretty cool; when at the ſame time near the cieling the heat is intolerable.

To obviate this inconveniency he caus'd a ſpiral tube of copper, *b*, *c*, to be placed cloſe to the inſide of the bell, and fix in ſuch manner that the ſame may be taken out and cleans'd at pleaſure, and with eaſe; and at the ſame time not encumber the diver, when he is in the bell: At the upper end of the tube *b*, a flexible leather tube is join'd 2 foot long, at the end of which is a turned ivory mouth-piece, which the diver (as ſoon as he perceives the air to grow hot in the top of the bell) keeps conſtantly in his mouth; which may be done by means of the flexible tube in whatever poſture he is in, as ſtanding, ſitting, bending his head, &c. and all the while he draws his breath thro' the abovementioned tube, and the air from *c*; by which contrivance he not only draws continually cool and freſh air as long as any is in the bell, but occaſions at the ſame time a circulation, which is ſo neceſſary to the very being of air (eſpecially in a compreſs'd ſtate) and its preſervation for the uſe of animals; a thing he has found of great conſequence; and ſo much the more neceſſary, as any body who has been in a diving bell for a long time, without any new ſupplies of air, and has been reduced to the laſt extremity of breathing in the ſame, will agree, that when at ſuch a time the bell begins to be haul'd up, an d by that means the compreſſed air is allow'd to expand and is put into motion never ſo little, the man receives a new life as it were, and incredible comfort and eaſe.

Again, when in coalpits, levels are drove in the coal or thro' dykes, the air of the level or adits growing hot by the breath and ſweat of the hewers and workmen for the want of a circulation of the air; M. *Triewald* has found it to be an excellent remedy, to place, along the ſide of the drift or adit, a ſquare

wood

wooden box, open at both ends, laid from the place where the air is cool and good, and reaching, by joining one box close to another, as far as where the work is carried on. And thus by this simple contrivance, a circulation of air is obtain'd, and sometimes to that degree, that when a candle is held at the end of the box, where the cool air enters, the flame is driven out by the current of cold air entering and circulating thro' the box.

By this experiment he is apt to think, that tho' the diver should not keep the end of the flexible tube in his mouth, which he may do with all the ease in the world, yet that the air would circulate thro' the copper tube, and he receive no small benefit by it: DDDD are the weights for sinking the bell, contriv'd in such manner as with great ease to be hook'd on the same hanging on the cable. The iron plate E, fixt to the chains FFF, serves the diver to stand upon, when he is at work.

The bell is very well tinn'd on the inside; and as in all rivers, and the coasts of the *Baltic*, the water is exceeding clear and limpid; because there is no ebb and flood, M. *Triewald* has placed 3 strong convex *lens*'s GGG: By these means the diver can not only see what is under him, but likewise on all sides at a good distance.

These glasses have strong copper lids, HHHH, like snuff boxes; which lids are shut, when there is no occasion to discover any objects in the bottom of the sea, and serve to preserve the glasses from being broken.

A Description of the Moose-deer *of* New England, *and a sort of* Stag *in* Virginia; *together with some Remarks on Mr.* Ray's *Description of the flying* Squirrel *of* America; *by Mr.* Samuel Dale. Phil. Trans. N° 444. p. 384.

THE moose-deer has been mention'd by several authors; but their accounts have generally been so very imperfect that little satisfaction hath thereby been given to the curious enquirers into natural history. The first mention that Mr. *Dale* finds made of this animal is by Mr. *Josselyn*, in a little tract, call'd *New England's rarities*; where p. 19. he writes, 'that it is a goodly creature, some of which being 12 foot high, their horns exceeding fair, with broad palms; some being 2 fathoms from the top of one horn to the other.' Much to the same purpose is the account he gives of this animal in another book of his, called 2 *voyages to New England*, where p. 88 he says, 'that the moose or elke is a creature, or rather a

'monster of superfluity, when full grown, being many times 'bigger than an *English* ox.' What *Neal*, in his *History of New England* Vol. II p. 573, hath of this animal, call'd by him the *mose*, is copied from the aforesaid *Josselyn*. The best and fullest account of this animal was sent by Mr. *Dudley*, and publish'd *Phil. Trans.* N° 368. p. 165, where he makes them to be of 2 sorts, *viz.* the common light grey moose, call'd by the *Indians*, *Wampoose*; and the large or black moose. As to the grey moose, Mr. *Dale* takes it to be no other than that Mr. *John Clayton*, in his account of the *Virginia* quadrupeds, publish'd in *Phil. Trans.* N° 210. p. 122, calls the elke; which in the *Memoirs for a Natural History of animals*, publish'd at *Paris* and english'd by Mr. *Pitfield*, p. 167, is call'd by the name of the stag of *Canada*, of which Mr. *Dale* hath seen a single horn, sent by Mr. *Mark Catesby* from *Virginia* by the name of an elke's horn, and was in all respects like those of our red deer or stags, only larger, weighing about 12 pounds averdupois; and from the burr to the tip measur'd by a string about 6 foot high. Mr. *Dudley* writes that his grey moose is likest the ordinary deer; that they spring like them, and herd together sometimes to the number of 30 in a company. But whether he means the red, the *Virginian*, or the fallow deer, is uncertain, he having said nothing of their horns, which was necessary to distinguish them. The black moose is accounted by all, that have hitherto writ of it, a very large creature. The above-mention'd Mr. *Josselyn* makes it many times bigger than an ox; and Mr. *Dudley* writes, that the hunters have found a buck or stag-moose 14 spans high from the withers; which at 9 inches to the span, is 10 foot and ½; and that a doe or hind of the fourth year, kill'd by a Gentleman near *Boston*, wanted but one inch of 7 foot in height. The stag, buck, or male of this kind hath a palmed horn, not like that of our common or fallow deer, but the palm is much longer, and more like that of the *German* elke; from which it differs, in that the moose hath a branched brow antler between the burr and the palm, which the *German* elke hath not.

Fig. 3. Plate VIII. represents the head, or rather the attire (as it is called in heraldry) of a black moose-deer, which was sent Mr. *Dale* from *New England*; the dimensions of which are, as follows:

A B	56	inches
C A	34	
C E	31	
C D	34	
D H	30	
F G	9½	
F I	14	
K L	7	

The horn of this *New-England* black mooſe agrees not in figure with either of thoſe mentioned in *Phil. Tranſ.* N° 227. p. 489. and N° 394. p. 123, found foſſil in *Ireland*; the laſt of which Mr. *Kelley* writes, that for want of another name, they call'd them elks-horns. Mr. *Dale* ſuſpects that thoſe horns Mr. *Ray* mentions in his *Synopſis methodica animalium quadruped.* to have ſeen with Mr. *Holney*, an apothecary at *Lewis* in *Suſſex*, as alſo in divers *Muſeums*, were not the horns of this black or *American* mooſe, but of the *German* elke; becauſe that inquiſitive gentleman takes no notice of any brow-antlers they had, which Mr. *Dale* thinks was too notorious to have eſcaped his obſervation had there been any ſuch.

As to the number of young ones, or calves, which the mooſe brings forth at a time, authors vary: For, Mr. *Dudley* ſaith, that they bring forth but two: But *Joſſelyn* in his *two Voyages*, p. 89; and from him *Neal*, that they bring forth three; and that they do not go ſo long pregnant, as our hinds, by two months. What theſe two laſt mentioned authors write as to their caſting their calves a mile diſtant from each other, doth not ſeem probable; nor does Mr. *Dale* find, that *Neal*, in his deſcription of this creature, makes any mention of their having a long tail, tho' charged ſo by Mr. *Dudley*, who likewiſe omits the brow-antlers in his deſcription of their horns.

There is another beaſt of the deer kind, which though very common in *Virginia*, and undoubtedly, in other of the northern provinces of *America*, yet ſo far as Mr. *Dale* knows is not deſcribed by any author. Mr. *Beverly* in his *preſent ſtate of Virginia* mentions both elke and deer in that country, but doth not deſcribe either.

But by what Mr. *Dale* receiv'd from Mr. *Catesby*, the firſt ſhould be the *Canada* ſtag, and the other, the deer here mentioned. Mr. *Clayton* likewiſe mentions the elke, which he

he ſaith are beyond the inhabited parts, aud are the ſame with Mr. *Beverley*'s; as alſo the deer of which he ſaith there are abundance, yet he doth not deſcribe them, but calls them red deer, though they are not the ſame with what we here call by that name, but of thoſe that follow.

That which Mr. *Dale* takes for the undeſcribed deer, is of the ſtag-kind, having round horns like them, not ſpreading out as in the ſtag or red deer, but meeting nearer together at their tips, and bending forwards over the face of the animal; the brow-antlers are not crooked, ſtanding forwards, but ſtreight and upright, as repreſented Fig 4. the dimenſions of which are as follows.

a b 11 inches
a cb 20
a d 12 $\frac{1}{2}$
d f 12 $\frac{1}{2}$
d e 11
g h 2 $\frac{3}{4}$

The skin of this deer is of a ſand colour, with ſome black hairs intermix'd, and while young ſpotted all over with white ſpots, like ſome ſorts of fallow deer; being likewiſe about their ſize when full grown. The *Dama Virginiana Raii Synop. Animal. quadruped.* p. 86. which was formerly in St. *James's-Park*, ſeems to be different from this; if Mr. *Willoughby* was not led into a miſtake in taking it to be of the palmate kind, by only ſeeing it when the horns were ſhed: Perhaps this laſt of Mr. *Ray* may be the maurouſe of *Joſſelyn's Voyages*, p. 91. which he ſays is like the mooſe, only his horns are but ſmall, and the creature about the ſize of a ſtag; but his deſcription is too ſhort to be ſatisfactory.

There are other ſorts of deer mentioned by Mr. *Joſſelyn* in his laſt quoted book, p. 87. as natives of that country, as the buck, ſtag and rain-deer: But whether they are the ſame with thoſe call'd by the ſame names in *Europe*, Mr. *Dale* cannot determine; the deſcriptions of them being omitted. Mr. *Joſſelyn* likewiſe mentions as another ſort of *American* deer, an animal call'd a maccari, caribbo, or pohano: But by the account he gives, it ſeems to be a fiction; no ſuch animal being, Mr. *Dale* thinks, in *rerum natura*

Mr.

Mr. *Ray* in his Synop. quad. p. 215, rather refers the *Sciurus Amerioanus volans* to the mouse than to the squirrel kind, because their tails are broad aud plain, and not turn'd over their backs when they sit; which mistake may, probably, arise from only seeing the skin of one dead, when the hair of their tails had been eaten off by mites: For, in one Mr. *Dale* saw alive, which was brought over from *Virginia*, the tail was hairy, as in others of the squirrel kind, tho' rather thinner; and it turned over the back as in other squirrels.

Dr. *Mortimer* observes, that the same species of flying squirrels hath been found in *Poland*; a description of which together with an accurate Fig. is given by M. *Klein*, *Phil. Trans.* N° 427.

And that as to the large horns found fossile in *Ireland*; he has taken particular notice (in several he saw) besides the main horns being palmated, that the brow-antlers are so likewise; a circumstance peculiar to the rain-deer species, being of great service to them in removing the snow, in order to get at the grass or moss underneath, which is their chief subsistence in *Lapland*.

An Attempt to explain the Phenomenon of the Horizontal Moon appearing bigger than when elevated several Degrees above the Horizon, supported by an Experiment; by Dr. Desaguliers. Phil. Trans. N° 444. p. 390.

THIS apparent increase of the moon's diameter (which a telescope with a micrometer shews to be only apparent) is owing to the following early prejudice we have imbibed from children.

When we look at the sky towards the zenith, we imagine it to be much nearer to us, than when we look at it towards the horizon: So that it does not appear spherical; according to the vertical section EFGHI [Fig. 5. Plate VIII.] but elliptical, according to the section *e* F *g h i*. The sky thus seen strikes the eye in the same manner as the long arch'd roof of the isle of a cathedral church. or the cieling of a long room.

This being premis'd: Let us consider the eye at C (Fig. 5.) upon the surface of the earth; and imagine C at the surface to coincide with K at the centre; to avoid taking into consideration that the moon is really farther from the eye when in the horizon, than when it is some degrees high. Now when the moon is at G, we consider it as at *g*, not much farther

farther than G: But when it is at H, we imagine it to b at *h*, almoſt as far again. While, therefore, it ſubtends th ſame angle nearly as it did before, we imagine it to be ſ much bigger, as the diſtance ſeems to us to be increas'd.

To illuſtrate this, the Dr. contriv'd the following experi ment:

He took two candles A B, C D, (Fig. *6.*) of equal heigh and bigneſs; and having placed A B at the diſtance of ſix o eight foot from the eye, he placed C D at double that di ſtance; then cauſing any unprejudiced perſon to look at th candles, and asking which was the biggeſt. The ſpectator an ſwer'd, they were both of a bigneſs; and that they appear' ſo, becauſe he allow'd for the greater diſtance of C D; an this likewiſe appeared to him when he look'd through ſmall hole. Then deſiring the ſpectator to ſhut his eyes f a little, the Dr. took away the candle C D, and placed th candle E F cloſe by the candle A B; and tho' it was as ſho again as the others, and as ſmall again in diameter, th ſpectator, when he opened his eyes, thought he ſaw th ſame candles as before. Whence it is to be concluded, th when an object is thonght to be twice as far from the eye before, we think it to be twice as big, though it ſubtends bu the ſame angle.—— And this is the caſe of the moon, whic appears to us as big again, when we ſuppoſe it as far agai though it ſubtends but the ſame angle.

The difference of diſtance of the moon in *perigæo* an *apogæo*, will account for the different bigneſs of the hor zontal moon at different times, adding likewiſe the con deration of the faintneſs, which vapours ſometimes thro on the appearance.

An Explication of the preceding Experiment to account f the appearance of the horizontal Moon; by the ſam Phil. Tranſ. N° 444. p. 392.

DR. *Deſaguliers* made an experiment with three ivo balls for confirmation of what he had advance namely, that the deception ariſes from our judging the hor zontal moon to be much farther than it is, which is as fo lows:

1. Two equal ivory balls (Fig. 7. Plate VIII.) were f one beyond the other in reſpect of the eye at E; name A B at 20 foot diſtance from the eye, and C D at 40.

2.

2. It is certain by the rules of optics, that the eye at E or F ſhall ſee the ball C D under an angle, but half as big as it ſees the ball A B; that is, that the ball C D muſt appear no bigger than the ball op placed by the ſide of A B.

3. But when looking at the two balls with the naked eye in an open room, we conſider that C D is as far again from the eye as A B, we judge it to be as big as A B, (as it really is) notwithſtanding it ſubtends an angle but of half the bigneſs.

4. Now if unknown to the ſpectator, or while he turns his back, the ball C D be taken away, and another ball op of half the diameter be placed in the ſame line, but as near again, at the ſide of A B, the ſpectator thinking this laſt ball to be at the place of C D, muſt judge it to be as big as C D; becauſe it ſubtends the very ſame angle as C D did before.

It therefore follows, that if a ball be imagined to be as far again as it really is, we make ſuch an allowance for that imagined diſtance, that we judge it to be as big again as it is, notwithſtanding that the angle, under which we ſee it, is no greater than when we look at it knowing its real diſtance.

For this reaſon the moon looks bigger in the horizon, and near it, than at a conſiderable height, or at the zenith; becauſe it being a common prejudice to imagine that part of the sky much nearer to us which is at the zenith, than that part towards the horizon: When we ſee the moon at the horizon, we ſuppoſe it much farther; therefore, as it ſubtends the ſame angle, or nearly the ſame, as when at the zenith, we imagine it ſo much bigger, as we ſuppoſe its diſtance greater.

The reaſon why this experiment is hard to make is, becauſe the light from the ball op is too ſtrongly reflected on account of its nearneſs: But if we could give it ſo little light as to look no brighter than the ball C D it would deceive every body. The Dr. made the experiment ſo as to deceive ſuch as were not very long ſighted: But he owns he found it very hard to deceive thoſe who ſee at a great diſtance; tho' they would all be deceiv'd, if the diſtances were of 300 or 400 foot. Now in the caſe of the moon, the deception is help'd; becauſe the vapours, through which we ſee it when low, take away of its brightneſs; and therefore have the

ſame effect as would, or does happen in the experimen when the light of the ball *o p* ſtrikes the eye no ſtronger th the light of the ball C D.

Some Obſervations on a Man and Woman bit by Vipers; *Dr.* Atwell. Phil. Tranſ. N° 444. p. 394.

July 3. 1734. THE ſame man, who had been bit fo merly by a viper in the preſence of ſ veral members of the *Royal Society*, was again bit in the pr ſence of ſeveral others beſides Dr. *Atwell*, in the publick h of *Exeter College* at *Oxford*. He receiv'd two punctures the wriſt, a little above the thumb; the blood iſſued, a more venom lay upon the orifices than could be imme ately imbibed. He complained in about half an hour's tim that the poiſon was got up to his ſhoulder, and was ente ing his body. But notwithſtanding this, he was not ſuffer to apply his remedy (*ſallad oil*) till one hour and 10 m nutes after he was bitten; by which time he began to flushed and in a ſweat, his hand ſwoln and diſcoloured.

Upon an application of his medicine, he found ſo abatement of his pain; but the ſwelling appear'd more ſible, and ſpread itſelf farther into his arm. In about a qu ter of an hour the man ſunk under the table, and co plain'd of violent pain in his back and bowels, nor could bear to be mov'd. At laſt, his pulſe failing, his jaw bei fallen, his countenance changed, and eyes fixt, he w ſtretch'd upon the table, and the medicine applied to belly, and ſtomach. Soon after which, recovering a little, began to vomit, and he brought up more than a quart phlegm and bile. In this condition he lay for more than hour, and then was remov'd into the Doctor's lodgings; wh he was ſeiz'd again with a fit of vomiting, and likewiſe p ging, and continued ſo till midnight. The Doctor kept h in his houſe upwards of an hour in hopes of his grow better; but his diſorder ſtill continuing, and he being weak and feeble even to ſtand, the Doctor ſent him ho in a chair to his own lodgings, where he was put into b and after midnight fell aſleep, and waked next morning p fectly well, only that his arm was ſtill ſwoln, and the fl pitted, as if it had been dropſical. His arm was bound in papers dipt in his own medicine (*ſallad-oil*) and this all, as far as the Doctor could obſerve or learn, that was a plied to it.

T

The same day two young chickens were bit; one died in wo hours, and the other in four hours time. A third was it three times; and then had the medicine applied; but it ied at the end of 10 hours. The flesh of this last was rown very black, and there was much extravasated lymph etween it and the skin, which stunk intolerably: But the Doctor could not perceive, that the viscera were at all dis-olour'd.

July 4. Another fowl, half grown, was bit in two places, nd the medicine was applied; in half an hour after, the owl eat and seem'd much recover'd, but was dead in 14 ours time.

July 6. Two half grown cocks were bit; the first was bit ut once, yet violently, and turned black immediately. It ad the medicine applied, eat afterwards, and seem'd pretty ell; yet died in 20 hours. The other was bit two or three imes, but hardly wounded, and not half so much discolour'd s the former: The wound was bath'd with viper-oil, but he fowl died in a little more than two hours.

July 8. Two young pigeons were bit, the one had viper-oil pplied immediately, but it sicken'd and died in four hours: he other had oil-olive applied, and recover'd perfectly: e flesh beginning to return to its natural colour in about n hour's time.

July 17. The woman was bit in the publick hall of *Bra-ennose-College*, in the presence of Dr. *Frampton*, Dr. *Frewen*, nd several other physicians. It had been suspected, that ey play'd some tricks with their vipers, and made them end their rage and venom beforehand: To obviate which physician of the company had provided some fresh vipers, hich he had caught himself a day or two before, and kept his own custody till that time. The woman was bit twice y one of these, and receiv'd three wounds; one in the umb, and two in the fore finger: Her hand was soon swoln d spotted, and her finger turn'd black. After 23 minutes e applied the medicine to her hand, but no farther than the elling went, by which Dr. *Atwell* suspects the following lness was in some measure occasion'd. She walk'd home ry well in appearance. But in about three hours after the te was receiv'd, she grew very sick and was in great pain; d was seiz'd with vomiting, purging, fainting fits, which ntinued upon her all night; insomuch that the people the house despair'd of her life: Nor had she any sleep

till noon the day following. The Dr. saw her about 6 that evening, when she awaked, he found her very well in spirits, but complaining of most acute pains in her finger. Her arm, shoulder, back, and breast, on that side, were much swoln and inflamed: All those parts thus affected were bound up in papers soak'd in the medicine. After this there appear'd upon her finger 2 large bladders, full of a black corrupt matter; and this not only upon the wound, but one of them was upon a part of the finger distant from it. She could not be persuaded to open them, which the Dr. believes would have eas'd her very much.

July 20. the swelling was considerably abated, and almost reduced entirely into her hand, which began to pit: But she complained still of her finger; and could hardly endure to have it dress'd with fresh papers. She continu'd in bed till the 22d, for the sake of keeping her hand in a more easy posture; and then she came abroad.

The same day that the woman was bit, they caus'd a fowl to be bit; but the wound was not deep, and little more than a scratch. Nothing was applied to it, and it died in 24 hours.

A large puppy was bit the same day 3 times in the head, had the medicine applied, but it died in about an hour.

As it was known that the man and woman kept themselves fasting on those days when the experiment was to be tried upon them: This occasion'd a suspicion that they might take some antidote to prepare their bodies; for which reason Dr. *Atwell* order'd the man to bring him some vipers after dinner, under pretence of making some farther experiments on dogs; providing at the same time some fresh vipers without his knowledge, and then the Dr. propos'd to him to be bit by one of them, and apply his medicine immediately. His hand was besmear'd with the medicine in applying it to a young dog, on which the experiment was just made. Two vipers were tried on the man, but neither would bite him: One of them attempted it several times, and spilt his venom, but always caught back his head again, as if there had been something offensive in the hand. Upon this, suspecting that the smell of the medicine might occasion it, he was made wash his hand, after which another viper bit him immediately: But whether this conjecture was right or not must depend upon farther trial. The man receiv'd the bite on the joint of the thumb, and the blood issu'd at the 2 orifices. He applied the medicine directly: The thumb soon appeared black, the hand was swoln, and the flesh pitted immediately

mediately. He drank a mug of ale after it, and then went home to bed. His whole arm was swoln; but he was so well that he went 6 miles out of town, and came home again in the evening. The Dr. saw him again, when the swelling was almost gone above the elbow, but the flesh pitted below: The wound had blister'd, but the bladders were fill'd with a water, and not any thing of that black matter, which appear'd on the woman's finger.

A young dog, mention'd before, was caus'd to be bit the same day, and the medicine applied: Another dog was bit 3 times in the nose, and nothing applied: Both were much swoln, but very likely to live.

The teeth of a viper's head cut off 24 hours before, was likewise thrust into the flesh of a fowl, which turned black immediately, but the fowl perfectly recover'd without any application.

Some electrical Experiments intended to be communicated to the Royal Society; *by Mr.* Stephen Gray, *and taken from his Mouth the Day before he died; by Dr.* Mortimer. Phil. Trans. N° 444. p. 400.

Exp. 1. TAKE a small iron globe of an inch or an inch and a half in diameter, which set on the middle of a cake of rosin of about 7 or 8 inches diameter, having first excited the cake by gently rubbing it, clapping it 3 or 4 times with the hands, or warming it a little before the fire: Then fasten a light body, as a small piece of cork, or pith of alder to an exceeding fine thread, 5 or 6 inches long, which hold between your finger and thumb, exactly over the globe, at such a height, that the cork, or other light body, may hang down about the middle of the globe: This light body will of itself begin to move round the iron globe, and that constantly from west to east, being the same direction which the planets have in their orbits round the sun. If the cake of rosin be circular, and the iron globe placed exactly in the centre of it, then the light body will describe an orbit round the iron globe, which will be a circle: But if the iron globe be placed at any distance from the center of the circular cake, then the light body will describe an elliptical orbit, which will have the same eccentricity, as the distance of the globe from the centre of the cake.

If the cake of rosin be of an elliptic form, and the iron globe be placed in the centre thereof, the light body will describe

ſcribe an elliptical orbit, of the ſame eccentricity as the form of the cake.

If the iron globe be placed in or near one of the *focus*'s of the elliptic cake, the light body will move much ſwifter in the apogean than in the perigean part of the orbit, contrary to what is obſerv'd of the planets.

Exp. 2. Take the ſame or ſuch another iron globe, and having faſten'd it on an iron pedeſtal about an inch high, ſet it on a table; then ſet round it a glaſs hoop, or portion of a hollow glaſs cylinder of 7 or 8 inches diameter, and 2 or 3 inches high: This hoop muſt be firſt excited by warming and gently rubbing it; then hold the light body ſuſpended as in the firſt experiment, and it will of itſelf move round the iron globe from weſt to eaſt in a circular orbit, if the hoop be circular, and the globe ſtand over the centre thereof; but in an elliptic orbit, with the ſame eccentricity, if the globe does not ſtand in the centre of the hoop, as in the firſt experiment, when the globe does not ſtand on the centre of the cake.

Exp. 3. This ſame iron globe being ſet on the bare table, without either the cake of roſin or glaſs hoop, the ſmall light body being ſuſpended as in *Exp.* 1, 2, will make revolutions round it, but ſlower and nearer to it than when it is placed upon a cake of roſin, or within a glaſs-hoop.

Mr. *Gray* had not found that theſe experiments would ſucceed, if the thread, by which the light body was ſuſpended, was ſupported by any other thing than a human hand: But he imagin'd it might happen the ſame, if the thread ſhould be ſupported or faſten'd to any animal ſubſtance whatever; and he intended to have tried the foot of a chicken, a piece of raw fleſh, or the like.

Mr. *Gray* thought to explain the foregoing particular by the following odd phenomenon, of which he aſſur'd Dr. *Mortimer* he was very certain, having often obſerved it; *viz.* if a man reſting his elbows on his knees, places his hands at ſome ſmall diſtance from each other, they will gradually accede to each other, without any will or intention of the man to bring them together; and they will again recede of themſelves. In like manner the hand will be attracted by the body; or the face of a man, if he ſtand near a wall, will be attracted to the wall, and be again repell'd by it.

Mr. *Gray* told the Dr. he had thought of theſe experiments only a very ſhort time before his falling ſick, that he had not

tried

tried them with variety of bodies, but that from what he had already seen of them, which struck him with new surprize every time he repeated them, he hoped, if God would spare his life but a little longer, he should, from what these phenomena point out, bring his electrical experiments to the greatest perfection; and he did not doubt but in a short time he would be able to astonish the world with a new sort of *planetarium* never before thought of; and that from these experiments mihgt be established a certain theory for accounting for the motions of the grand *planetarium* of the universe.

In trying these experiments since Mr. *Gray*'s death, the Dr. found that the small light body will make revolutions round a body of various shapes and substances, as well as round the iron globe, if set on the cake of rosin. Thus he tried with a globe of black marble a silver sand-dish, a small chip box and a large cork. He observ'd that the cake, if nothing stood upon it, would in any part strongly attract the light body, as held suspended by the thread; but when the globe or other body was set upon it, the edges of the cake attracted the strongest; and so gradually the attraction seem'd as it approach'd the centre to become less, till at a certain distance it was changed into repulsion, which proceeded from the globe, or other body placed upon the cake, which very strongly repels the light body, unless it be held very near it, and then it attracts it strongly. While the light body is suspended, as in the foregoing experiments, if you approach the finger of the other hand near it, it will fly from the finger, or be very vigorously repell'd by it.

Some thoughts on the Sun *and* Moon *appearing bigger when near the Horizon than when near the Zenith; by Mr.* James Logan. Phil. Trans. N° 444. p. 404.

IT may, perhaps, be needless to add any thing in confirmation of Dr. *Wallis*'s solution (vide *Phil. Trans.* N° 187.) of the sun and moon's appearing so much larger at rising or setting than when in a greater altitude; tho' some have very absurdly still gone on to account for it from vapours. It is true, indeed, that it is these vapours, or the atmosphere alone, that make those bodies, when very near the horizon, appear in a spheroidal form, by refracting, and thereby raising (to sight) the lower limb more than the upper, yet these can be no cause of the other phenomenon. The sun and moon, each subtending about half a degree, appear in the meridian of the breadth of 8 or

10

10 inches, to some eyes more, and to others less; and in th
horizon to be 2 or 3 foot, more or less, according to the exten
of ground they are seen over. But if one can have an oppor
tunity as Mr. *Logan* frequently had at *Philadelphia*, of seein
the sun rise or set over a small eminence at the distance of
mile or two with tall trees on it, standing pretty close, as
usual in woods without underwood, his body will then appea
to be 10 or 12 foot in breadth, according to the distance an
circumstances of the trees he is seen thro': And where there ha
been some thin underwood, or a few saplings, Mr. *Logan* ha
observ'd that the sun setting red, has appear'd thro' them like
large extensive flame, as if some house were on fire beyon
them. Now the reason of this is obvious, *viz.* that being we
acquainted with trees, the idea's of the space they take up a
in a manner fix'd; and as one of those trees subtends an ang
at the eye, perhaps not exceeding 2 or 3 seconds, and wou
scarce be distinguishable, were it not for the strong light behi
them, the sun's diameter of above 30 minutes takes in sever
of them; and therefore will naturally be judged vastly larg
Hence it is evident, that those bodies appear greater or le
according to the objects that interpose or are taken in by the e
on viewing them. And to this only is that phenomenon to
imputed.

Mr. *Logan* is sensible this method of arguing is not new;
the observations here given may probably tend to illustrate t
case beyond what has been advanced on the subject.

The Case of a Lad *bitten by a mad* Dog; *by Mr.* E
ward Nourse. Phil. Trans. N° 445. p. 5.

STEPHEN *Bellass*, about 16 years of age, was so
time in *June* 1735 bit by a mad dog thro' the nail of
right thumb. Mr. *Nourse* being immediately call'd, propos
to make a ligature above, and cauterize the wounded part: B
that not being complied with, he desir'd Mr. *Gernum*, the ap
thecary, to make up the remedy, mention'd by *Dampier*
Phil. Trans. N° 237 and 443, viz. ℞. *Lichen. ciner. terrestr*
piper nig. a a ℥ I. *f. pulvis.* Of this powder the lad took
drachm within an hour after he was bit; repeated it next mo
ing before he set out for *Gravesend*, where he was 10 days, a
dipt in the salt water every day; during which time he repea
the medicine evening and morning; and he continu'd so to
for 40 days.

He had not the leaſt ſign of being affected by the poiſon, till *Tueſday* the 11th of *January* 1736-7, when in the evening he complain'd of a numbneſs in 3 of the fingers of the hand that was not bit: Next morning he was ſick, had great pain acroſs his ſtomach and in all his bones; in the evening Mr. *Nourſe* was ſent for to bleed him, the people about him ſuppoſing he had got cold. When he came he found him feveriſh, with a hard full pulſe, and the complaints aforeſaid: Upon enquiring what nouriſhment he had taken that day? He made anſwer, one: For, he could not ſwallow: Whereupon Mr. *Nourſe* ook'd into his mouth, but there was no inflammation; neither lid any thing occur to him that could poſſibly produce the difficulty of ſwallowing, complain'd of: He was offer'd ſome ſack-whey in a baſon, but he ſtarted at the ſight of it, neither would e ſuffer it to come near him: He was then offer'd a ſpoonful, hich he was prevail'd on to ſwallow; the moment it was own, he was convulſed, and a remarkable horror appear'd in is countenance, ſucceeded by a profuſe ſweat all over his face d head: He afterwards took another ſpoonful; the conſe-uence was the ſame as before, but in ſomewhat a higher de-ree: Mr. *Nourſe* was now convinced that this was the ὑδροφοβία, d that it aroſe from his having been bit 19 months before: or, after the moſt ſtrict enquiry, it did not appear that he had en bit by any animal ſince.

Mr. *Nourſe* acquainted his friends with his apprehenſions, d deſir'd farther advice. Upon which Dr. *Monro* was ſent , who order'd him to be let blood, and to repeat the above-ention'd medicine in a bolus every 4 hours, and a clyſter: e was blooded, and the clyſter injected; but he could not be evail'd on to take but one of the bolus's. This night was ent with great inquietude, and without any ſleep: *Thurſday* rning he was generally convulſed, and had frequent reachings d yawnings alternately: About noon his mind (which till n continued ſound) left him, and he rav'd and foamed at the uth till 5 o'clock in the afternoon; at which time nature med quite ſpent, and he lay very quiet till 7, when he died.

Thus the poiſon lay latent in this lad near 19 months; a g which never fell within Mr. *Nourſe*'s obſervation before, ' mentioned in books.

Mr. *Nourſe* had cut this lad for the ſtone the preceeding mer; namely about a year after he had been bit; and he er ſaw a wound more diſpos'd to heal; for, the lad was well l abroad in 5 weeks.

An Explanation of the Runic Characters *of* Helsingland *by M.* Andrew Celsius. Phil. Trans. N° 445. p. 7.

IT is well known that there are stones found in sever parts of *Sweden*, which were formerly set up as obelis in memory of the dead. These monuments are marked wit the ancient northern letters, call'd *Runor* or *Runic charac ters*. But in *Helsingland* a province of north *Sweden* ther occur 5 of those stones, which have characters cut into them that seem to differ from the common *Runic*. Upon the in troduction of our modern letters, these *Runic* characters be came so little regarded, that their interpretation was lost eve to the *Swedish* antiquaries till the year 1674, when M. *Mag nus Celsius*, Grandfather to our author, astronomy profess at *Upsal*, reviv'd their reading,, and drew up the alphab of them (Fig. 1. Plate IX.) ranged after the manner of th ancients.

There are but 16 letters; and the words are frequent distinguish'd either by 3 points set perpendicularly over o another: or by two at some distance asunder.

Among the several alphabets hitherto known, it would b a hard matter to find one like the foregoing, except the ch racters of the *Persepolis* inscriptions, which have not hithe to been decypher'd: For, the letters generally made use denote different sounds, according to their various shape Whereas in this alphabet the same character often denotes different sound, according to the diversity of its place an attitude between the two parallels. Thus a strait strok standing perpendicular to the parallel lines, signifies I, F, and S: For, when it joins these parallels, it signifies I; whe it rests on the lower parallel, it signifies F, on the upper, S and D, when it touches neither of them. The small wed leaning to the right, and placed near the upper parallel, de notes L; in the middle, N; and O, near the lower para lel; a line descending from the upper parallel, and maki a curve downwards to the left, stands for K; the same plac contrarywise from the lower parallel upwards, expresses R and so of the rest.

The intention of the first inventor of these letters seems have been, to form all the characters of small wedge straight and crooked lines, and 2 points, variously placed b twe

tween the 2 parallels: For, the wedges may be placed 15 different ways, as represented in Fig. 2.

The straight line may also have 15 different situations, as in Fig. 3.

The crooked lines may likewise be varied 14 different ways, as in Fig. 4.

In fine the 2 points admit of 12 variations, as in Fig. 5.

But as the ancient *Suevo-Gothi* had but 16 letters in their alphabet, they did not want all these variations of the wedges, lines and points: Wherefore they employ'd six variations of the wedges; five of the straight lines; three of the crooked; and but two of the points.

If we now suppose these *Helsingic* characters to be older than the common *Runics*; the greatest part of the common *Runics* may easily be deriv'd from the *Helsingics*, by adding a perpendicular line to the small wedges and curves; as appears by Fig. 6.

But if we suppose the common *Runics* to be older, and to be deriv'd, as is very probable, from the ancient *Greek* and *Roman* letters; we must contrarywise deduce the *Helsingic* characters from the common *Runics*, by substracting the perpendicular line.

As a specimen Fig. 7. represents a stone found at *Malstad*: M. *Celsius* took an exact copy of it *Anno* 1725, in company with his uncle Dr. *Olave Celsius*; of whom is expected a complete account of all these *Helsingic* inscriptions.

On the outer limb or border is what is represented Fig. 8.

In the first curvature as in Fig. 9.

In the second snake dragon as in Fig. 10.

In the inner limb as in Fig. 11.

In the 2d curvature as in Fig. 12.

In the first snake as in Fig. 13.

In the heads of the snakes as in Fig. 14.

That is, *Frumunt* erected this stone to *Fisiulfi* the son of *Brisi*: But *Brisi* was the son of *Lini*: But *Lini* was the son of *Un*: But *Un* was son of *Fah*: But *Fah* the son of *Duri*: But he the son of *Barlaf*: But he (the son) of *Drun*: But he (the son) of *Lanas*: But he (the son) of *Fidrasiv*. *Frumunt* the son of *Fisiulfi* made these *Runic* (letters). We have placed this stone to the north of *Bala* stone. *Arva* was the mother of *Fisiulfi*. *Siulfir* (or *Fisiulfir*) was the Governour of this province. His place of abode was in *Rimbiun*.

That this monument was erected since Christianity began to flourish in *Sweden*, sufficiently appears by the figure of the cross. It is moreover probable, that *Fisiulfi*, as the Governour of the province, was descended of a very noble family; seeing his genealogy is traced 10 generations backwards: Now if we suppose *Frumunt* to have been 30 years of age when he erected this monument for his father, and with Sir *Isaac Newton* allow 30 years for each generation; we shall find 330 from the death of *Fisiulfi* to the birth of *Fidrasiv*, who is the stock of these generations.

There is a figure of this stone in M. *De la Motraye*'s travels; but with considerable errors in the windings of the snakes, and in the letters, as well as in the explanation given them.

A Lunar Eclipse *observ'd in* Fleet-street, London, March 15, *1735-6*; *by Mr.* George Graham. Phil. Trans. N° 445. p. 14.

H.	M.	S.	
10	13	0	The beginning.
11	11	0	The total immersion.
12	49	0	The emersion.
13	47	0	The end.

At *Greenwich*, Dr. *Halley* observ'd.

	H.	M.	S.
The beginning	10	13	37
The immersion	11	9	42.

Observations on the lunar Eclipse March 15, 1735-6 *at Mr.* Graham's *House in* Fleet-street, London; *by M.* Celsius, Phil. Trans. N° 445. p. 15.

THIS eclipse was observ'd with a reflecting telescope, of 11 inches, magnifying 63 times and made at *Edinburgh*.

H.	M.	S.	
10	22	5	The shadow on the middle of *Kepler*.
	23	15	Entering *Mare humorum*.
	28	16	——— *Copernicus*.
	29	34	——— the middle of *Copernicus*.
	30	26	*Copernicus* entire.

H.	M.	S.	
10	33	28	shadow enters on *Timocaris*
	38	44	— On *Tycho*
	39	12	— On the middle of *Tycho*
	40	48	*Tycho* entire
	46	0	The shadow enters on *Menelaus*
	49	20	On *Plinius*
11	0	40	On *Mare Crisium*
	5	36	*Mare Crisium* entire
	9	17	The total immersion is about to begin
13	13	55	*Tycho* emerged out of the shadow
	29	0	*Mare serenitatis* entirely emerged
	40	45	*Mare Crisium* entirely emerged
	45	50	The eclipse nearly ended
	46	12	Certainly ended.

Observations on the same Eclipse, in Covent-Garden, London; *by Dr.* Bevis. Phil. Trans. N° 445. p. 16. *Translated from the* Latin

True time p. m.

H.	M.	S.	
6	53	47	*Saturn* in the point of intersection of the threads of the micrometer.
7	31	5	The first of the hyades at ♌ passes the thread *a* (Fig. 15. Plate IX.) the telescope inverting.
7	31	50	— Passes the horary thread *b*.
7	32	35	— Passes the thread *c*.
7	42	39	*Saturn* again in the concourse of the threads.
8	19	57 $\frac{1}{2}$	The first of the hyades at ♌ passes the thread *a*
8	20	42 $\frac{1}{2}$	— *b*
8	21	27 $\frac{1}{2}$	— *c*
9	50	0	The disk of the moon runs along the horary thread in 139 seconds of time
9	56	0	Again in 139 seconds
0	01	0	And again in 139 seconds
0	9	40	A thin penumbra seems to darken the moon near *Hevelius*
0	10	20	Now a very sensible one
0	11	40	The beginning

True

True time p. m.

H.	M.	S.	
10	14	38	The limits of the ſhadow, as far as he coul judge, paſſes through *Grimaldus* and *Cava* *lerius*
10	19	46	Through *Ariſtarchus*
10	24	15	The ſhadow enters on *Mare humorum*
10	32	44	It covers *ſinus roris*
10	32	44	The moon ſcarcely ſeen through the clouds
10	40	18	The ſhadow divides *Tycho*
10	42	26	It touches *Mare ſerenitatis*
10	46	1	It touches *Menelaus*
			A black cloud comes on.
10	53	46	The cloud going off, *Mare nectaris* is foun entirely immerged.
			Very thick clouds do again intercept the sig of the moon
11	0	56	The ſhadow touches *Mare Criſium*
11	5	48	*Mare Criſium* and *mare fœcundum* immerg
11	10	0	The moon entirely immerged.
12	42	20	Now the eaſtern limb of the moon begins clear up
12	46	5	It grows ſtill clearer
12	46	56	A thread of pure light reſtor'd in the twin ling of an eye
			A great many flying ſmall clouds
12	57	5	The limits of the light touch *mare humoru*
13	4	3	*Mare humorum* intirely emerged
13	13	40	*Tycho* half emerged
13	14	0	Entirely emerged
13	17	22	*Waltherus* emerges

A great darkneſs by clouds, that, as it ſeem'd, would c tinue for ſome time

13	43	44	*Mare fœcundum* is obſerv'd without the ſ dow
13	46	25	The true ſhadow ends
13	48	30	The penumbra no longer ſenſible

In theſe obſervations the Doctor made uſe of a good cl that for ſeveral days before, and on the very day of eclipſe had been adjuſted by five correſponding altitu

of the ſun, corrected by the equation table, as alſo of a ſix foot teleſcope. About the middle of the eclipſe the moon was ſeen as through a duſkiſh ſmall cloud; but at the edges ſhe was red as glowing hot iron. The limits of light and ſhadow were all the time of the eclipſe not well defin'd.

Obſervations of the ſame Eclipſe, at Yeovil in Somerſetſhire, *Lat.* 50 *Degrees,* 52 *Minutes; by Mr.* John Milner. Phil. Tranſ. N° 445. p. 18.

The clock was firſt adjuſted by the equation table.

				Deg.	Min.
The beginning of the eclipſe at	10	6	0		
The moon's altitude then was				34	29
The beginning of total obſcuration	11	4	30		
The moon's altitude then was				34	16
The middle of the total obſcuration	11	54			
The end	12	43	30		
The moon's altitude then was				34	47
The end	1	39	15		
The altitude then was				31	47
The continuation of the total obſcuration was		1	39		
The duration of the whole eclipſe	3	33	15		

The Efficacy of Oil-olive *in curing the Bite of Vipers; by Mr.* Stephen Williams. Phil. Tranſ. N° 445. p. 26.

AT *Plymouth, June* 26, 1735, in preſence of ſeveral gentlemen of the faculty of phyſic, *William Oliver*, the viper-catcher (mentioned *Phil. Tranſ.* N° 443) ſuffer'd himſelf to be bit by a female viper; which being enraged, fix'd her fangs in the middle part of his fore-finger. There ſoon iſſued out blood from the wounds: But that the poiſon might the more ſtrongly appear, the ſame viper immediately bit a pigeon in the breaſt, which expired in leſs than half an hour. Another pigeon was alſo bit by the ſame viper, which likewiſe expired, tho' not ſo ſoon as the firſt. The man immediately complain'd of an acute pain in the wounded part; and it ſoon look'd red, and then became of a livid colour; his finger ſwelled to a great ſize; and he could not bend it. Soon after this his hand alſo began to ſwell: He complained of faintneſs, and pains flying to his arm, ſhoulder,

der, and arm-pit. In half an hour's time from the bite, hi ſpecific being applied, and ſtrongly rubbed into the par affected, procured him immediate eaſe: His pain abated his finger became flexible, and his ſpirits ſeem'd more chear ful: The ſpecific being ſeveral times repeated and applied his pains gradually diminiſh'd. The next day his finger an hand continued ſwoln, but without pain; the skin began t appear yellow, and puſtules like bladders appear'd on hi finger; which being prick'd emitted a ſanious liquor. I two days time all the ſymptoms vaniſhed, and he becam perfectly well.

June 30. The gentlemen of the faculty met again, whe ſeveral experiments were tried upon puppies, cats, an pigeons; wherein was found the efficacy of this man's ſpe- cific, and that to the great ſatisfaction of the company.

A Propoſal for the Admeaſurement of the Earth in Ruſſia, *by Mr.* Joſ. Nich. de L'Iſle. Phil. Tranſ. N° 445. p. 27.

NEceſſity, or the exigencies of geography and navigation put mankind very early upon the enterpriſe of meaſur- ing the earth: For, how is it poſſible to conſtruct maps of eac kingdom or empire, without ſetting down all the places in thei true diſtances, by the meaſures made uſe of in each country as were the *ſtadia* of the ancients; and now the miles, leagues werſts, *&c.* of the moderns. And how could different ſtates b compar'd with one another; ſo as to come at the knowledge o the ſpaces they ſeverally poſſeſs on the earth's ſurface, withou knowing the number of theſe common meaſures, contain'd in a degree, or in the whole extent of the earth? Hence aroſe th twofold method of determining the ſituation of the differen parts of the earth, either by their mutual diſtances, ſet dow in the meaſures made uſe of in each country; or expreſſed i meaſures common to all, as degrees, minutes, and ſeconds by marking the longitude and latitude of each place.

Upon the firſt determination of the magnitude of the earth in geographical meaſures, as in *Stadia* and *Arabian* miles, th ancients did not employ any great degree of exactneſs: They were content to ſet down the circumference of the earth and o its parts, in round numbers; probably, becauſe they did not ex- pect to be able to attain to much preciſeneſs in a reſearch o this nature: But according as their deſires of improving geogra- phy increaſed, by entering into a detail of it, they found i neceſſary to have a more exact knowledge of the magnitud of

of each degree, not only in the great meaſures, as miles and leagues, but alſo in perches, toiſes and feet; which could not be otherwiſe done than by geometrical operations and aſtronomical obſervations, more exact, and conſequently more operoſe, than had been, or indeed could have been, undertaken before.

M. *de L'Iſle* avoids entering upon a detail of the immenſe labours of modern Mathematicians on this head; as thoſe of *Fernel* in *France*; *Snellius*, *Bleau* and *Muſchenbroek* in *Holland*; *Norwood* in *England*; *F. Riccioli*, and *M. Bianchini* in *Italy*; and the gentlemen of the *Academy of Sciences* in *France*; to get only the preciſe magnitude of a degree in the meaſures of their reſpective countries: But he anſwers an objection, which might be rais'd hereon, *viz.* that it was needleſs to undertake theſe ſame operations in ſo many different places; ſince the magnitude of a degree once determin'd in the meaſures of any one country, may be eaſily reduced to the meaſures of any other, by the exact knowledge we now have of the proportions of modern meaſures.

Now taking *Ruſſia*, for inſtance, the geographical meaſures of which are werſts, divided each into 500 *ſagenes*, and each *ſagene* ſuppoſed to be exactly ſeven feet *Engliſh*, this relation once known, as alſo the exact relation of the *Engliſh* to the *French* foot, or to the toiſe of ſix foot, which the *French* aſtronomers made uſe of in their admeaſurements; and of which they found a degree of a great circle contained 57060; what more is requiſite for concluding that a degree of a great circle contains 104 werſts and $\frac{1}{2}$? And what remains to the perfection of the geography of *Ruſſia* in the moſt minute detail that can be enter'd upon, but to employ this meaſure of werſts, ſagenes, and *Engliſh* feet (if you pleaſe) in actual admeaſurements; and to conſtruct the maps by the moſt exact methods of geometry; taking care to ſet them down right, as to their true bearings, and to regulate them by the moſt exact aſtronomical obſervations of longitude and latitude that can poſſibly be made.

But M. *de L'Iſle* makes it appear, that the geography of *Ruſſia* cannot be brought to this pitch; not only in the general map, but likewiſe in that of any particular diſtrict whatſoever; without undertaking an equal, and even a greater work than all that hitherto has been done in *France* and elſewhere, towards the admeaſurement of the earth.

 When

When it was said above, that an exact knowledg of the magnitude of a degree of the earth in any know measures of one country was sufficient for constructin exact maps of all other countries, only having a rega to the different proportion of the measures, that is to b understood upon a supposition of the earth's being perfectl spherical: Seeing it is well known, that in a sphere the de grees of all the great circles are every where equal; an that we likewise know, in a sphere, the proportion of th degrees of the lesser circles to their great parallels, accord ing to their distance from them.

But if the earth be not perfectly spherical, the case quite alter'd: All the degrees of the great circles will n be equal to one another, and those of the lesser, taken at certain distance from their parallel great circles, will n have the same relation that the degrees of the lesser circl taken at the same distance, would have on a sphere. In this there might possibly arise an infinite variety, accor ing to the figure the earth might have: And as it has n been hitherto decided, what is the true figure of the eart and that there is no better method for ascertaining it, th by observations made in so great an extent as that of *Russia*

For these reasons M. *de L'Isle* has advanced, that the p fection of the geography of *Russia*, stands in need of th great undertaking: But before he enters into a detail of t great advantages of this research, and the nature of the op rations he proposes, he thinks it necessary to explain in wh manner he means that the question of the earth's figure a magnitude is not yet decided,

There have been some who have long since suspected, a even thought, they were furnished with proofs of the ea not being exactly spherical. M. *de L'Isle* here intirely a stracts from the unevennesses of its surface; which are n sensible in regard of the earth's whole bulk; seeing the t of the highest mountains, and those even few in numb are scarce more than a league above the level of the s Wherefore, he supposes the earth to be bounded by a cu surface, such as it would be by the level of the sea carri quite over all the earth. It is in this manner, the earth ing considered as cover'd with a fluid, that Sir *Isaac Ne ton*, in the first edition of his *Principia*, published in 16 has demonstrated, that supposing this fluid homogeneo and the earth to have been at rest at the time of its cr

ti

tion, it muſt have aſſumed the figure of a perfect ſphere: But afterwards ſuppoſing it to have a motion on its axis, as is well known it has in 24 hours; this ſpherical figure muſt have been changed into that of a ſpheriod, flatted at its poles, in which the degrees on the meridian muſt be greater, drawing nearer the poles than near the equator.

Sir *Iſaac* confirms this hypotheſis of the earth's figure by obſervations of the diminution of the ſimple pendulum upon approaching the equator; to which Dr. *Pound* adds the analogy the earth has with ſome of the other planets, as *Jupiter*, which ſometimes appears oval, its leaſt axis being that about which it performs its revolution.

This opinion of Sir *Iſaac Newton* has likewiſe been maintained by M. *Huygens*, tho' with ſome ſmall difference: But in 1691 M. *Eiſenſchmid* (in his diatribe de figura telluris elliptico-ſpheroide; ubi unà exhibeter ejus magnitudo per ſingulas dimenſiones, conſenſu omnium obſervationum comprobata, Argentorati, apud Joh. Frider. Spoo, 1691. 4to. p. 54. cum fig.) having compar'd the admeaſurements of the earth made in different latitudes, as that of *P. Riccioli* in *Italy*; of M. *Picart* in *France*, and of *Snellius* in *Holland*; and having found that the degree, which reſulted from thoſe different admeaſurements, continued to become leſs in drawing nearer the poles, (which is quite the contrary of what follows from the earth's figure, ſuppoſed by Sir *Iſaac Newton* and *Huygens*) M. *Eiſenſchmid* was thereupon of opinion that the earth was longer at the poles.

This opinion of M. *Eiſenſchmid* was afterwards confirm'd by the late M. *Caſſini*, in the obſervations of the meridian of *Paris*: For, in 1701, having carried on theſe operations to the *Pyrenean* mountains, which is a ſpace of above ſeven degrees and $\frac{1}{2}$, he found, that as he advanced to the ſouth, theſe degrees increaſed $\frac{1}{800}$ part, or 72 toiſes each degree.

Since the meridian of *Paris* was in 1718 carried on northwards to the ſea, M. *Caſſini*, the younger, found, upon comparing more than eight degrees, which this meridian contains from ſea to ſea, that the increaſe, going northwards, was but from 60 to 61 toiſes each degree; as may be ſeen in the large treatiſe publiſhed in a ſeparate volume, as a ſequel to the *Memoirs of the Royal Academy of Sciences* at *Paris* for the year 1718. Theſe reaſons did not hinder Sir *Iſaac Newton* from perſiſting in his firſt opinion of the figure of the earth being flatted at the poles, as appears in the 2d and 3d editions of his *Principia*, publiſhed in 1713 and 1726: And

it is very ſurpriſing, that by this very figure of the earth he demonſtrates a certain motion it has, to explain in the *Copernican* ſyſtem the preceſſion of the equinoxes, or the apparent motion of the fixt ſtars in longitude. Sir *Iſaac* finds the inequality of the degrees on the meridian, in ſo ſmall an extent as that of *France*, not ſenſible enough to be poſſibly determin'd by immediate obſervations; and he is of opinion, that we ought more to rely on the obſervations of the ſimple pendulum, and on the other principles which he has built upon, to conclude the earth flatted at the poles.

In 1720 M. *Mairan* attempted to reconcile the two different hypotheſes of Sir *Iſaac Newton* and M. *Caſſini*, by imagining that the earth, at its creation, being without motion was of a much more oblong figure than that which *Caſſini* thinks it has at preſent: So that it might have been reduced to that which it now has, by the diurnal motion on its axis, *&c.* But Dr. *Deſaguliers*, who is of Sir *Iſaac Newton*'s opinion, has made appear in *Phil. Tranſ.* N° 388, that M. *Mairan*'s ſuppoſition is contrary to the laws of motion; and he has moreover propos'd ſeveral conſiderable doubts on the obſervations and ſuppoſitions made uſe of by M. *Caſſini* in his determination of the earth's figure in 1718.

As ſoon as the meridian of *Paris* had been extended from one ſea to the other; and M. *Caſſini* had thence deduced a confirmation of the ſyſtem of the earth's being longer at the poles; M. *de L'iſle* deviſed a new method of deciding the queſtion, by the obſervation of the degrees of the parallel, compared with thoſe of the meridian

For that purpoſe he conſider'd, that as the degrees of the meridian and thoſe of the parallel, at the ſame elevation of the pole, had different relations, according to the different figures aſcrib'd to the earth; nothing more was requiſite for concluding which hypotheſis was the true one, than to determine this relation by immediate obſervation.

Having ſuppoſed that there had been obſerved on the parallel of *Paris*, a ſpace nearly of the ſame magnitude with that on the meridian, that is, of about 13 degrees; ſince that on the meridian is about 8 degrees and ½; M. *de L'iſle* found by an exact calculation, that according to the figure M. *Caſſini* has given to the earth, this ſpace ought to contain 13 minutes and ½ of the parallel more than in the hypotheſis of the earth's being ſpherical; which appeared to him conſiderable enough to be able to decide between theſe two hypotheſis, and by a

ſtronger

ſtronger reaſon, between the hypotheſis of Sir *Iſaac Newton* and M. *Caſſini*; ſince the difference ought to be ſtill more conſiderable than that now ſpecified.

M. *de L'iſle* concluded at leaſt, that independent of the figure of the whole earth, which could not be determin'd by the ſole obſervations made in *France* without making ſuppoſitions, and admitting principles which are ſtill liable to be conteſted; it would be of great conſequence towards conſtructing exact maps of the kingdom, to aſcertain this relation by obſervations, which conſiſted only in forming triangles along the parallel of *Paris*, and obſerving at the two ends the difference of the meridians, by the moſt exact methods.

The difference, he has now mention'd, ſeem'd to him to be ſo conſiderable, that he was in hopes of being able to determine it by means only of 2 places within ſight of each other, and ſituate to the eaſt and weſt; provided their difference of longitude were accurately obſerv'd, independently of aſtronomical obſervations, by means of lighted fires; after the manner that M. *Picart* put in practice in *Denmark*, for determining the difference of longitude of the aſtronomical tower at *Copenhagen* and *Uraniburg* in the iſle of *Huen*. With this intent, in *April* 1720, M. *de L'iſle* went ſome diſtance from *Paris* ſouthwards, to the places he judged propereſt for his purpoſe: But his deſign was not then executed, for want of aſſiſtance, and for other reaſons, he omits to mention.

Since that time M. *de L'iſle* ſaw with pleaſure, that M. *Poleni* had hit upon the ſame thought with him; as may be ſeen in his letter to the Abbè *Grandi*, dated *November* 1724.

The deciſion of this famous queſtion of the earth's figure had ſtopped here; when in 1733, the miniſter of *France* having thought it neceſſary to conſtruct an exact map of the whole kingdom; and being informed that the work could not be better carried on than by the aſtronomers of the *Royal Academy* of *Sciences*, applied to M. *Caſſini* on that head; who was of opinion, that in order to execute it with the utmoſt exactneſs, the ſame method ought to be made uſe of as for the meridian, by making thro' the whole extent of the kingdom, triangles linkt together, by means of objects ſeen ſucceſſively one from another, &c. This project of making a map of *France* by ſuch triangles had been already offer'd to M. *Colbert* by M. *Picart* in 1681, but was not then executed. However M. *Caſſini* propos'd, that theſe triangles ſhould be begun in a direction perpendicular to the meridian, in order to render theſe operations

of

of ſervice towards the deciſion of the earth's figure, purſuant
the method ſpoken of above: And M. *Caſſini*, having in perſ
undertaken theſe operations, and carried them that ſame ye
viz. 1733, from *Paris* to St. *Malo*, whoſe longitude from *P*
ris M. *Picart* had obſerv'd in 1681; the relations of the d
grees on the meridian and parallel were found to be ſuch as we
requir'd in the hypotheſis of the earth lengthen'd at the pol
and even more lengthen'd than *Caſſini* had determin'd in 171
For, inſtead of the diminution of a ſixtieth part for each d
gree of the parallel, which M. *de L'iſle* had found according
the earth's figure, as determin'd by *Caſſini* in 1718, this lat
deduced from his operations in 1733, a diminution of the 3
part of each degree.

True it is, that M. *Caſſini*, in the account he gave of t
determination at a publick meeting of the *Royal Academy*
Paris Nov. 14. 1733, does not give it as entirely ſure; beca
the longitude of St. *Malo*, with regard to *Paris*, was collec
but from one obſervation only of *Jupiter*'s firſt ſatellite, whe
in there may poſſibly be ſome error: But at leaſt M. *Caſ*
ſeems certain, that there is a very conſiderable diminution in
degrees of the parallel of *Paris*; which confirms his opin
of the earth's being longeſt at the poles. This we are likely
have a better certitude of hereafter, ſince this admeaſurem
of the parallel of *Paris* is carrying on in *France* by M. *C*
ni's ſons, M. *Miraldi*'s nephew, and ſeveral other young
thematicians, inſtructed by M. *Caſſini* in this ſort of work.

It has been already ſaid, that all theſe operations perform
in *France*, for the figure and magnitude of the earth, could
ſerve to determine the earth's figure out of *France*, without
aſſiſtance of certain hypotheſes; unleſs the ſame thing w
undertaken and carried on in the other regions of the ea
more ſouthern and northern than *France*. It is upon this co
deration, that the *Royal Academy of Sciences* took up the
ſolution of ſending ſome aſtronomers to make the like obſer
tions as near the equator and the poles as poſſible; which
the places where the difference of the degrees on the meri
ought to be the greateſt, according to the different hypoth

In *April* 1735, three mathematicians and aſtronomers of
Academy, *viz.* M. *Godin*, *Bougher*, and *De la Condamin*
out from *France* for the province of *Quito*, the moſt nort
part of *Peru* in *America*; in order to obſerve, juſt under
equinoctial line, the magnitude of ſome degrees of the meri
and equator.

As to the other mathematicians and astronomers of the same Academy, viz. M. *de Maupertuis*, *Camus*, *Clairaut* the younger, and *Monnier*, the younger, who have been sent to the north, they departed from *France* in *April* 1736, with M. *Celsius*, professor of astronomy at *Upsal*, who accompanied them as far as the bottom of the gulph of *Bothnia* in *Sweden*, where they might measure about a degree on the meridian at its crossing the polar circle: But as by the last accounts M. *De L'isle* had of them, they had not finish'd their operations; it is not yet known whether the magnitude of the degree measur'd by them, favours the opinion of M. *Cassini*, or that of Sir *Isaac Newton*: All we know is, that they have found the length of the simple pendulum favourable to the latter, that is, longer under the polar circle than farther south. M. *De la Croyere* had already found the same thing: For, being at *Archangel* in 1728, he there observed, in the exactest manner he possibly could, the length of the simple pendulum, which he found to be $2\frac{1}{6}$ of a line longer than at *Paris*.

We are likewise informed by the other Astronomers gone to *Peru*, that in their way towards the equator, being at St. *Domingo*, in Lat. 18 degrees, 37 minutes, they there found the pendulum swinging seconds to be about 2 lines shorter than at *Paris*. Thus, all we hitherto know from those Gentleman, on their expeditions to the north and to the line, confirms the opinion of Sir *Isaac Newton*, and his adherents: And yet M. *Mairan* pretends, that this shortning of the pendulum in drawing nearer the equator, is in one sense entirely independent of the earth's figure.

Thus it appears from the foregoing account, that the question concerning the earth's figure is not yet decided: Nay, it is not impossible, that after finishing all the observations which are actually making, new difficulties may arise, and new objections be started, that may prevent its being entirely decided. However all this work cannot fail throwing a great deal of light on this important question, and procuring considerable advantages to geography, astronomy and natural philosophy.

It is with this view, and particularly to render such important service to the geography of *Russia*, that M. *De L'isle* thinks it necessary to undertake a work of that nature in *Russia*; towards executing which, there are great advantages, which other nations have not. One of the principal, is the great extent of *Russia* every way: For, were the meridian of the *Imperial Observatory* of *Petersburgh* to be determined, it might be carried

carried to between 22 and 23 degrees; which is a fourth part of the distance from the pole to the equator. The meridians of *Mosco* and *Astracan* are not of less extent; and consequently by the admeasurement of some one of these meridians, might be determined more exactly, than could have hitherto been done, the inequality that subsists between the degrees of the meridian.

This is what the Great *Cassini* wish'd for; when, after having in 1701, determin'd this inequality by the extent of 7 degrees observ'd in *France*, as mention'd above, he says, that this fact might be verified by mensurations of greater extent, if the other princes of the earth did contribute as much as the King of *France* towards the perfecting of sciences.

In the great extent, which might be given to the meridian of *Petersburgh*, as aforesaid, there would be the advantage of knowing, by operations linkt together, or uninterrupted, the magnitude of some degrees equal to those which have been measur'd in *France*; and to that which the *French* astronomers have measur'd in *Sweden*; and not only all the degrees between the two, which the *French* astronomers have not had in their power to observe, but also some degrees farther northward than that measur'd by them in *Sweden*.

As the exigencies of geography require the triangles, taken for the determination of the meridian, to be continu'd on every side, and principally in directions perpendicular to the meridian, or according to the parallels: With what great exactness may we not then determine the proportion of the degrees on the parallels to those on the meridian, by means of the vast extent of the *Russian* empire; which on its western side extending as far as all the dominions of *Europe* from the most northern to the most southern, has no other bounds to the east than the east itself, so to speak; seeing its extent that way contains near half the earth?

Another great advantage to be obtain'd by the work M. *De L'isle* now proposes to be made in *Russia* is, that coming after others, the benefit of all their knowledge and experience in the like kind of admeasurements will be reaped: Whence one may expect to succeed, and execute it better than could have been done elsewhere, by applying timely remedies against the difficulties that occurr'd in other places.

These operations are to be founded on a basis of the greatest length possible; which must be actually measur'd, and with the greatest exactness that may be; as it is to serve as a founda-tion

tion to the admeasurement of all the triangles: And in this point too there is a very great conveniency near *Petersburg*, seeing on the ice there may be measured out a basis, greater than has been hitherto taken; namely from the coast of *Ingria* about *Peterhoff* to the coast of *Finland* towards *Systerbeck*. There is no less than 20 wersts distance between these 2 extremities; and this great distance may be measur'd very exactly, this year especially, *viz.* 1737, that the ice is very even: Moreover, as this basis is situate between the isle of *Cronstad* and *Petersburgh*, in a direction nearly perpendicular to the distance from *Petersburgh* to *Cronstad*; there can be no better method for inferring thence, by exact observation of the angles taken at the extremities of this basis, the distance from the centre of the *Imperial Observatory* to the steeple of the New Church of *Cronstad*; which 2 objects are seen reciprocally from each other, and are not less than 30 wersts asunder: And this distance once known exactly will serve as a foundation for all the triangles that are to be taken; of which each of the sides may have not less than from 30 to 40 wersts, according as objects shall be found advantageously situated for that purpose. There is the mountain of *Donderhof* to begin with, which, with the *Imperial Observatory*, and the steeple of *Cronstad* Church, forms one of the most convenient triangles imaginable for the subject proposed.

In taking observations at these 3 places may be seen, if others of the same advantageous situation can be discover'd: But when no remarkable objects are found of the situation and distance sought for, they must be erected on purpose, in the same manner as was of necessity done in other countries. And this may be done in *Russia* with more ease; since, in places where the woods intercept the sight, small towers may be rais'd, at very little expence, out of these same woods, with signals placed on them, which may be seen as far as is required. In open places, where consequently wood is not so common, signals alone, without towers, will suffice.

The most necessary instruments for executing this undertaking, are, besides the ordinary astronomical instruments, a common quadrant of between 2 and 3 foot radius, for observing the angles of the triangles that shall be taken; and a portion of a circle of the greatest radius that can be conveniently had, for observing the arches of the heavens corresponding with the distances measur'd on the earth.

The quadrant ought not to have a radius of more than be-tween 2 and 3 foot: For, if it be bigger, it cannot for the mo[st] part be made use of in steeples and other places of considerab[le] height, where it is requisite to observe: But also if it be le[ss] than 2 foot, it will not give the quantity of the angles with su[f]ficient exactness.

As to the other instrument for observing the arches of th[e] heavens, its radius ought not to be less than from 12 to 15 foot but it is not necessary that it should contain a large portion of circle: It is only requisite to have this portion somewhat larg[er] than the arch of the heavens intended to be measur'd. Thu[s] as the meridians, which may be traced in *Russia*, can be e[x]tended but between 22 and 23 degrees, as already mention'd, will suffice, that the instrument employ'd therein be a porti[on] of a circle of 30 degrees.

M. *Picart*, for his first operation, got an arch of a circ[le] made of 18 degrees and of 10 foot radius, with which thought himself sure within 2 or 3 seconds: And no other i[n]strument was made use of in the chief observations for the m[e]ridian of *Paris*. The astronomers who are gone to *Ameri[ca]* carried with them an instrument of 12 foot radius, and of portion of a circle of 30 degrees. But those come to *Swed[en]* contented themselves with a portion of a circle of 5 degrees a[nd] $\frac{1}{2}$, and 9 foot radius: But this instrument made by Mr. *Geor[ge] Graham*, a very able mechanic in *London*, is by its constructi[on] so exact, that the astronomers who have us'd it, think the[m]selves sure to 2 seconds. The one for the observations in *Ru[ssia]* should be made by the same artist, and of the same co[n]struction.

It is with such an instrument that Mr. *Bradley*, a celebrat[ed] *English* astronomer, has discover'd in the meridian altitudes some fixt stars, certain constant and annual variations, whi[ch] do not proceed either from the variation of the refractions, from the parallax of these stars; or in fine, from any nutat[ion] or wavering of the earth's axis; but which he accounts for the successive motion of light.

Whatever be the cause of these variations, (which cau[se] as well as its effect are not hitherto, perhaps, entirely clea[r'd] up) as they may possibly happen in the space of time req[ui]site to be spent in making the observations for the meridi[an] or in passing from one end of the meridian to the other; i[t is] necessary with the same instrument, or such another t[hat] is of pretty near the same exactness, to examine the vari[a]ti[ons]

ions of the ſtars made uſe of. Wherefore it would be of onſiderable advantage, not only for the obſervations of the dmeaſurement of the earth, but alſo for all the other princi- al reſearches in aſtronomy to have orders given for procu- ing two mural quadrants of Mr. *Graham*'s making, and of he ſame conſtruction, as has been alrealy ſpecified; for hich there are already walls raiſed at the *Imperial obſerva- ory*, in the plane of the meridian.

With theſe two quadrants, which might be of ſeven foot adius, and the moveable teleſcope 9 or 10 foot long, obſerva- ions of the utmoſt accuracy might be made, ſuch as the pre- ent ſtate of aſtronomy requires.

Beſides theſe inſtruments now mentioned, which are ab- olutely neceſſary to a ſolid eſtabliſhment of aſtronomy and eography in *Ruſſia*, there are ſtill ſome other ſmaller inſtru- ents, that may be of conſiderable uſe in the operation pro- oſed, or that may ſerve to make other curious and uſeful bſervations at the ſame time, that thoſe for the admeaſure- ent of the earth are making.

When the ſides of the triangles, taken for meaſuring the arth, terminate at very elevated places, as on the tops of the igheſt mountains, it is neceſſary to reduce theſe triangles to hat they would be, had they been obſerv'd in horizontal lanes ſituate upon a level with the ſea. For this purpoſe uſt be known the height of the mountains above the evel of the ſea, which cannot always be determined geo- etrically, or would at leaſt be too tedious to perform: herefore, in the meridian of *Paris*, which croſs'd very igh mountains, M. *Caſſini* was of opinion, that he ought fix their height by a ſhorter method, which is that f the height of the ſimple barometer, obſerv'd on the top of ach mountain, and compar'd with that obſerv'd at the me time in another place, whoſe elevation above the level f the ſea was known. But as that method ſuppoſes the nowledge of the proportion, which the different fallings of e mercury, keep with the different heights to which the arometer is carried; and as natural philoſophers are not hi- erto entirely agreed on this head, for want of obſervations ſufficient accuracy: Hence it happened, that Dr. *Deſa- uliers*, making appear that M. *Caſſini* has not made uſe the moſt exact proportion, found reaſons for correcting, or leaſt for doubting of ſome of *Caſſini*'s calculations. Thus muſt be by the aſſiſtance of new experiments, better cir- mſtantiated than thoſe hitherto made, and purſuant to a

theory entirely agreeing with these experiments, that th[...] method may be employ'd with certainty, for determining th[e] height of mountains by the barometer, and reducing the a[n]gles observ'd from the tops of these high places, to what the[y] would be, if they had been observ'd on a plane horizont[al] with the level of the sea: Now these new observations m[ay] be made on the way in tracing the meridian; and for th[is] purpose M. *de L'Isle* begun to construct compound barom[e]ters, which, by the peculiar nicety of their make, will ser[ve] with accuracy to observe the quantity of the mercury's fa[ll] at the different elevations, to which they shall be carrie[d] in order to fix with greater certainty the proportion of th[is] fall: And in the construction and use of these instrumen[ts] he proposes to provide against the effects of heat; which, [as] it is different in the different times and places of maki[ng] these experiments, may possibly produce apparent variatio[ns] of which it is necessary to keep an account.

There is still another method of determining the elevati[on] above the level of the sea of all the points, in which t[he] triangles terminate, that are made for the admeasurement [of] the earth: And this may be done by beginning these oper[a]tions near the sea, and actually measuring how many toi[ses] and feet the planes of the first stations are elevated abo[ve] the level of the sea: For, if the angles of the apparent el[e]vation of the second stations, seen from the first, be aft[er]wards observ'd, it will be an easy matter, from the known d[i]stances, to reduce the true elevations of the latter above t[he] former; and consequently above the level of the sea, maki[ng] proper allowances in the calculations for the difference of t[he] apparent level from the true one: In this method nothing [is] to be apprehended but the variation of refractions; but [for] this a remedy may be found, for the most part, by returni[ng] upon one's steps, that is, by reciprocally observing the fi[rst] stations seen from the second: For, if it be found, that [as] much as the second station appears elevated above the fir[st], so much the first is depressed below the second, except t[he] small difference which must arise according to the given [di]stance, it will be a proof that the refraction has been of [no] prejudice.

The observations and determinations of the true heights [of] all the places, which are to be visited, will not be the le[ast] laborious of those that are to be made in these journies; b[ut] their usefulness will be a sufficient recompence for the tr[ou]ble; since they will afford us the means of knowing [...]

the chief unevennesses of the ground travers'd by these great triangles; which being compar'd with the length of the course of the rivers, may give us room to judge of their rapidity, of the ease or difficulty of their communications, &c.

The other considerable observations and experiments to be made in the journies, undertaken for such enquiries, are the observations of the magnetic needle, both as to its dip and variation: But chiefly the observations of the length of the simple pendulum; which at present is become requisite to be observ'd with as much exactness and in as many places as possible.

All the operations and observations here propos'd, however arduous and difficult they may prove, have no other end than the benefit of geography: those who are to have the management of this enterprize must be attended by several surveyors and other mathematicians of *Russia*, who are to be instructed on the road, and employ'd at the same time in lesser operations with smaller instruments: By which means the maps of the countries, taken in by these great triangles, may be verified. And thus according as this work advances, the finishing stroke may be given to the maps of *Russia*.

The actual Mensuration of the Basis proposed in the preceding Dissertation: by the same. Phil. Trans. N° 445. p. 50.

M. *De L'Isle* actually undertook to measure the basis mentioned above, and he had the good fortune to measure it exactly on the ice, by taking the precise distance between the castle at *Peterhoff*, and the castle of *Doubki*, situate opposite to it on the *Finland* coast. He found the distance between the opposite walls of these castles 74, 250 feet *English*. This basis being much greater than any of those hitherto employ'd for this purpose, gives room to expect great exactness in the whole work, when it shall be carried on in the same manner: It will at the same time serve to make a very exact map of the bottom of the gulph of *Finland*.

It is for the same purpose, and for better ordering the charts of the coasts of the *Baltic*, that he intended (as soon as his project shall be approved in its full extent) to begin to measure his triangles along the coasts of *Ingria* and *Livonia*, to the islands of *Dagho*, *Oesel*, &c. And to the end that the charts of the places taken in by these triangles might be finished

finished at the same time, he design'd to take with him all the charts of these parts, which could be had, in order to verify and correct them in his way.

He likewise intended to publish, as soon as possible, all the operations and observations he should make in his expedition; that thus, early benefit might be reap'd from them; and that the publick at the same time the charts come out, might be acquainted with the foundation on which they are constructed. What retarded the publication of the whole detail of his operations in taking the basis, that is, of the precautions he used in ascertaining it, was his employing *English* feet in measuring, which he had a mind to reduce tot he *Russian* measure; but as it was requisite to consult the original standards on this head, which he had not hitherto been able to procure, he was for these reasons obliged to delay the publication of these first observations.

Observations of two Parhelia, or mock-suns, seen December 30. 1735; *as also of an Aurora Borealis,* December 11. 1735. *by Mr.* Timothy Neve. Phil. Trans. Nº 44[illegible] p. 52.

ON *Tuesday* the 30th of *December*, 1735. betwixt *Cherry Orton* and *Alwalton* in the county of *Huntingdon*, he observed two parhelia; the first of which shone so bright that at first he took it for the real sun; till looking a little farther on his left hand, he saw the true sun, much the brightest, in the middle, and a mock-sun on each side, in a line exactly parallel to the horizon. He guess'd their distance to be about 40 diameters of the sun, or as they usually appear 23 degrees. That on the left hand of the sun, when he saw it first, was small and faint; but in about two minutes time it became as large and bright as the other, and appeared at once like two white lucid spots on each side of the sun, east and west, seemingly as big, but not so well defined. In about three minutes they lost both their colour and form, and put on those of the rainbow; the red and yellow in both were very beautiful and strong next the sun, the other colours fainter. They became as two parts of an arch, or segment of a circle, with the concave part towards the sun, only round at top, the light and colour streaming downwards and tending towards a point below: This continued for four or five minutes, when the colours gradually disappearing, they became, as before, lucid spots, without any distinc-

tion

tion of colours: They lasted a full hour; sometimes the one brighter, and sometimes the other, probably according to the variation of the clouds and air. When Mr. *Neve* first saw it, it was exactly a quarter after 11. There had been a frost in the morning, which went away pretty soon with a thick mist; and between 10 and 11 o'clock it clear'd up, leaving only a haziness in the air behind it: The weather quite calm, wind, as he thought, at N. W.

These *parhelia* are commonly seen with a circle or halo round the sun, concentrical to it, and passing thro' the disks of the spurious or mock-suns: But there was not the least appearance of such a circle here; it having only a tendency towards one, when it was seen with the rainbow colours.

The other phenomenon was that pretty common one of the *Aurora borealis*; of which tho' there are so many exact and curious accounts in the *Philosophical Transactions*; yet Mr. *Neve* does not remember any one in the manner he saw this of the 11th of *December* 1735.

A little after 5 o'clock, he observ'd the northern hemisphere to be obscur'd by a dusky red vapour; in which, by degrees there appear'd several very small black clouds near the horizon. He thought it seem'd to be a preparation for those lights, which were afterwards seen; the first eruption of which was within a quarter of an hour, full east from behind one of the small dark clouds, and soon after several others full north: These streams of light were of the same dusky red colour with the vapour, they first appear'd and vanish'd instantly. He observ'd eight or ten of these at once, about the breadth of the rainbow, of different heights, several degrees above the horizon, and they look'd like so many red pillars in the air; and no sooner did they disappear, than others shew'd themselves in different places: In about half an hour, this colour of the vapour gradually changed itself towards the usual white, and spread itself much wider and higher; and after that, appear'd as usual.

Observations of two Parhelia *seen at* Wittemberg *in* Saxony *on* Dec. 31, 1735, O. S. *by M.* Weidler. Phil. Trans. N° 445. p. 54.

DEC. 31, 1735. O. S. a little after 10 in the morning, a friend told M. *Weidler*, that several suns were to be seen in the heavens: Upon this the latter went directly into the garden adjoining to his house, and he immediately saw, near the sun

ſun S (Fig. 15. Plate IX.) on his left or weſtern ſide, the fo lowing particulars; namely the parhelion B, as big as the tru ſun. This mock-ſun was amidſt ſmall, round, white, cloud ſet thick and cloſe to one another: The part of the parhelio which faced the weſt, was not round, but broken, having abo a third part of its circumference open, and ſhooting out th long bright ſtream or tail B H: To this ſtream, both above an below, adher'd another ſtream F G, ſomewhat incurvated, wit its horns turned from the ſun weſtwards: The middle of th mock ſun ſhone with ſo great a light, that the naked eye coul not bear it; wherefore, he view'd it attentively thro' a gla darken'd with the ſmoke of a wax-candle: The light of th parhelion B appear'd much weaker than that of the true ſun its circumference, which faced the ſun, was red; in like mann that part of the ſtream F G, which was towards the ſun, w purple. Within the red border appear'd the other colours the rainbow, as yellow, green and azure: And the ſtream B was likewiſe embelliſh'd with red and yellow. Both edges this were reddiſh, and its middle yellowiſh. The ſun S w 15 degrees and ½ above the horizon; and its image B was ne the ſame altitude: For, he then found it to be 14 degrees. H meaſur'd the diſtance from S to B, more than once, and found it to be 20 degrees. The arch F G was near 6 degre in length. Moſt of the ſouth part of the hemiſphere was ove caſt with white clouds, interſperſed here and there with ſom darker ones: There were ſome thin clouds before the true ſu thro' which his rays eaſily paſſed: When thicker clouds ſu rounded the ſun, the brightneſs of the parhelion was leſſen'd The parhelion was now and then hid by dark clouds. The th white clouds, with which the northern part of the ſky was ove caſt, reach'd up to the zenith. Soon after his firſt obſervi the parhelion B, as he look'd up to the zenith, he ſaw the bea tiful rainbow C D E parallel to the horizon, with its hor turned to the north: It had the uſual colours of the rainbo all very diſtinct; the purple was on the ſide facing the ſu next to it was the yellow, then the green, and laſt, the azu A line, drawn from the ſun's centre to the middle D of the *ir* tended to the zenith, and was a portion of that vertical circ in which the ſun then was. The point D was 61 degrees d tant from the horizon; wherefore, the diameter of the rainb was 58 degrees: However, there was but part of the rainb C D E ſeen; the ends of which were ſometimes but 38 degr from each other: For, more or leſs of it appear'd at differ

tim

times; but ſcarcely above a fourth part of its circumference at any time. It was ſometimes ſeen among ſmall white clouds, which were about the zenith, and ſometimes in a clear ſky. It laſted till the ſun and moſt part of the ſky was overcaſt by thick clouds. The thickneſs of the rainbow CK, as well as M. *Weidler* could eſtimate by the naked eye, was one degree of a great circle.

But as the neighbouring houſes hinder'd his having a free proſpect eaſtwards from his garden, he went to another place, whence he had a full view of the hemiſphere: And having reach'd thither a little before 11, he immediately ſaw another parhelion A to the eaſt, 20 degrees from the ſun, as the foregoing was, and elevated 15 degrees above the horizon. This mock-ſun was not inferior to the other B in brightneſs: For, the naked eye could no more bear it than that; its light was white, its figure round, and its ſize equal to that of the ſun S. This parhelion A ſhot out the ſtream IL, which was rectilinear, white and reſplendent, 8 degrees in length; and as far as he could diſcover, void of colours: For, it appear'd among ſmall, white, broken, clouds; and laſted ſomewhat longer than the former, without changing its figure. Upon the ſun's being hid by thick clouds about half an hour after 11, both theſe mock-ſuns diſappear'd; but became viſible again, upon the ſun's ſhining bright.

The whole of the phenomena, obſerv'd in theſe parhelia, amounts to this; that the true ſun S was accompanied by 2 parhelia; both 20 degrees diſtant from the ſun, one on each ſide; and having nearly the ſame altitude with the ſun from the horizon. Above the parhelia, part of a rainbow ſurrounded the zenith; and each of the parhelia ſent forth a bright luminous ſtream or tail; one rectilinear and white, the other ſomewhat incurvated and colour'd. Moreover, from the weſtern parhelion, a ſtream parallel to the horizon, and ſomewhat pointed, extended itſelf on the ſide oppoſite to the ſun; and this ſcene laſted for the 2 hours of 10 and 11 before noon, till thick clouds put an end to it. There was no appearance of an entire *crown*, ſuch as uſually accompanies parhelia, and encircles the ſun; tho' M. *Weidler* obſerved the tract of the ſky near the ſun, both with the naked eye and thro' glaſſes.

As to the ſtate of the heavens on the 31. of *December*, when the parhelia were obſerv'd: Early in the morning a thick fog overſpread the horizon: About 9 o'clock this fog condenſed into ſmall drops of rain, which fell ſlowly: Soon after, the vapours

 were

were collected into thin clouds, particularly in that part abo[ut] the sun: Then the sky became clear about the north; a[nd] there blew a gentle wind a little to the south of the east.

After noon, clouds gather'd to the west: About 30 minut[es] after twelve, the whole hemisphere was overcast but in t[he] evening it became clear and serene on all sides. On the follow-ing days, from the 1st to the 6th of *January*, the sky was co[n]stantly cloudy, or dark and the sun seldom seen thro' the brea[ks] of the clouds. On the 7th, the weather clear'd up, whic[h] lasted 3 days. On the 10th, the whole hemisphere was ove[r]cast with clouds; and therefore this appearance of parhelia h[as] not been attended with any uncommon weather.

The publisher having sent M. *Weidler* an account of M[r.] *Neve*'s observation of the mock-suns, seen by him in *Englan[d]*, which seem to agree in so many circumstances with those se[en] by the other in *Germany*; M. *Weidler* in his answer saith 'That it seems to him very worthy of remark, that parheli[a] 'so very much alike, should appear two subsequent days [in] 'places so distant from each other; which indicates a simil[ar] 'state of the air or atmosphere in both.' This extraordina[ry] incident put M. *Weidler* upon writing an essay on the cause [of] parhelia: And accordingly he hath publish'd a small pamph[let] in *quarto*, intitul'd *Jo. Frid. Weidleri* commentatio de *parh[e]liis*, *Mense januarii* Anno, 1736, prope *Petroburgum Angli[æ]* & *Vitemburgæ Saxonum* visis. Accedit de rubore cæli ign[eo] mense *Decembri* Anno 1737 observato *corollarium*, *Vitemb[er]giæ*, 1738, in quarto.

An Observation of three Mock-suns *seen in* London, Septem-ber 17, 1736; *by Mr.* Folkes. Phil. Transf. N° 445. p. 59

SEPT. 17, 1736, a little after 7 o'clock in the morning, [as] Mr. *Folkes* was reading in a room that looks towards t[he] north-east he accidentally took notice of an odd stream of c[o]lour'd light, shooting upwards from the sun, as he th[en] thought, which shone thro' a thin waterish cloud: But rec[ol]lecting that the appearance was several degrees more norther[ly] than the sun's true place at that time, he immediately went [to] the window, and found what he had taken for the sun wa[s a] parhelion shooting out a short horizontal stream or tail towa[rds] the north; the sun itself shining pretty bright and clear at t[he] same time. He also observ'd that the stream he had at first s[een] was part of an arch concentric to the sun, and passing thro' t[he] parhelion: This arch was for a good way tolerably defin'd, a[nd]

ting

tinged with red on the inside, and a bluish white on the other. He then cast his eye to the other side the sun, where he observ'd a 2d parhelion, at the same distance from him towards the south, tho' not yet so bright as the first. He then went up to his leads, his prospect being too confined below; where soon after he was come, he found the phenomenon to improve considerably, the arch round the sun forming itself into more than a semi-circle, reaching almost to the horizon northwards and with very little discontinuance beyond the second parhelion towards the south. He then began to perceive a 3d parhelion, where the circle surrounding the sun, would have been cut by the vertical passing through him; and in the same place his circle was touched by the arch of another, in some sort confounding itself with it in the place where the 3d parhelion appear'd: This was a good deal fainter than the other two; and the last mentioned arch extended but a little way: So as to be difficult to determine where its centre lay; this arch was likewise colour'd, but with red on its convex part: He had some time before this likewise began to see another circle, surrounding the sun at the distance of about 45 degrees, which appear'd to be about twice the distance of the first; and this likewise encreasing whilst he was considering it, became little less than a semicircle, being likewise tinged with red like the other on the inner side. When this circle had thus pretty well formed itself, he also discover'd the arch of a 4th circle, touching this, or rather confounding itself with it in its highest part, and surrounding, as it seem'd, the zenith. Of this last circle he saw, when it was most compleat, better than half, and it was much stronger colour'd than any of the others, being of a bright red on its convex, and a good blue on its concave part. In the part where this circle blended itself with the larger of those that were concentric to the sun, their common part was nearly white, and brighter than the rest, tho' hardly enough, to call it a 4th parhelion. All which appearances are represented in Fig. 16. Plate IX. The principal mock-suns continu'd tolerably bright till near 8 o'clock, the southern part of the phenomenon improving as the northern part decay'd; and the southern parhelion was once so bright, that taking the advantage of a place where a chimney intercepted the true sun, it cast a very visible shadow. In like manner the white and luminous horizontal tail, that proceeded from this parhelion was much longer than that of the other, reaching at one time beyond the outer of the two concentric

circles. The parhelia themſelves, tho' very luminous, were however never defin'd with any exactneſs as to their diſks, but look'd as the ſun is ſometimes ſeen thro' a thin whitiſh cloud; and they were themſelves of a reddiſh colour on that ſide next the true ſun. About 8 the phenomenon was ſenſibly decreas'd, and had entirely diſappear'd by 20 minutes after.

A rupture of the Ileum *from an external Contuſion without any external Wound; by* M. Chriſtianus Wolfius. Phil. Tranſ. N° 445. p. *61*. *Tranſlated from the* Latin.

A Certain labouring man ended his days by a melancholy accident, as follows; a ſtone falling down upon his lower belly, ſtruck it ſo, that the place affected came indeed to view, but without any external wound. The day following about noon, the man, tho' pretty robuſt, contrary to all expectation, expired. Upon opening the abdomen, there was diſcover'd a large rupture in the *ileum*; ſo that it only adhered behind to the other guts with its contents diſcharg'd into the cavity of the abdomen. The liver was pale, quite void of its native colour; and even the lungs themſelves had receded from their natural ſtate, having loſt their natural colour. From the livid ſpot on the abdomen, M. *Wolfius* gather'd, that the ſtone had ſtruck with its ſharp end upon the belly, and that the gut was burſt by too great a tenſion, in the manner as incurvated bodies are broken in their ſuperior convexity.

Some new ſtatical Experiments; by Dr. Deſaguliers. Phil. Tranſ. N° 445. p. *62*.

WHEN a long and heavy body lying on the ground is to be rais'd up at one end (like a lever of the 2d kind) while the other end keep its place, and becomes the centre of its motion; the prop made uſe of to ſupport it at any point in its whole length, ſuſtains a certain preſſure from the beam. Now the Doctor's experiments are to ſhew, by a force drawing always in the direction of the prop, what is the quantity of the preſſure on the prop, according to the length of the prop, the angle it forms with the beam, or with the horizon; and the diſtance from the centre of motion of the beam at which the prop is applied: For, when the prop is taken away, the force drawing in the direction of the prop will keep the beam *in æquilibrio*; and a force ever ſo little ſuperior to the friction, added to the power, will make it overpoiſe

poiſe the beam, and raiſe it higher; but overcome the power and bring down the beam, if it be added or applied to the beam.

Tho' in every caſe or experiment we have this analogy taken from mechanical principles, *viz.* that the

Intenſity of the power :
Is to that of the weight : :
As the diſtance of the line of direction of the weight :
Is to the diſtance of the line of direction of the power.

Yet to find thoſe diſtances nicely in the ſeveral applications of the prop, we muſt have recourſe to geometrical conſtructions and reaſonings. With theſe and the algebraical expreſſions of the ſame, the experiments exactly agree.

All the Doctor propoſes now is to ſhew the experiments by means of a machine which he contrived for the purpoſe, and got executed with great nicety, not in ornaments, but only where nicety in a mechanical inſtrument ought to be obſerv'd.

In this machine, the iron bar, or parallelipiped repreſenting the heavy body, weighs 12 drachms, 12 penny-weight, 12 grains, or 6060 grains; and its centre of gravity is at the diſtance of 20 inches and $\frac{1}{2}$ from its centre of motion.

The props he makes uſe of are, the one of five, and the other of ten inches: To overcome the friction, allow'd for by certain rules in all caſes, he uſes a nice braſs pully of three inches in diameter, whoſe pivots are but $\frac{75}{1000}$ parts of an inch in diameter: So that the 60th part of the power, added to it, will, in all caſes, overcome the friction.

Caſe 1. In which the prop is perpendicular to the horizon, exemplified by two experiments.

Exp. 1. The prop is equal to five inches, and placed under a point in the bar 10 inches diſtant from the centre of motion. Here the power acting in the direction of the prop, able to keep the bar in that ſituation, or the preſſure ſuſtained by the prop, will be found 250 ounces, 17 penny-weight, 15 grains; and the friction 8 penny-weight, 15 grains. The foot of the prop is to be at eight inches and $\frac{48}{100}$ from the centre of the motion.

Exp. 2. If the ſame prop of five inches be placed under a point in the bar at 30 inches from the centre of motion, the power or preſſure will be eight ounces, 12 penny-weight,

13

13 grains; and the friction equal to two penny-weight, 2 grains. The foot of the prop is to be distant from the centr of motion 29 inches $\frac{58}{100}$ parts.

Case 2. In which the prop is perpendicular to the bar, exemplified by three experiments.

Exp. 1. Now let the prop (still five inches long) be place so as to be perpendicular to the bar in a point 12 inches distant from the centre of motion. Here the power expressiv of the pressure should be 19 ounces, eighteen penny-weigh 4 grains; and the friction six penny-weight, 15 grains: Bu on account of a correction necessary to be made to this (because the bar is thick as well as heavy, and the centre of gravity above the surface to which the prop is applied the power or pressure sustained will be only 19 ounces, 1 penny-weight, five grains; and the friction six penny-weigh 14 grains.

N. B. The distance of the foot of the prop in this case 13 inches from the centre.

Exp. 2. The prop here is 10 inches long (still perpendicular to the bar) under a point in the bar, 24 inches dista from the centre: The power equal to the pressure sustaine should be (if the bar were only heavy and not thick) ni ounces, 19 penny-weight, four grains; the friction thr penny-weight, 11 grains and $\frac{1}{2}$; but with the proper correction, which shall be explained hereafter; it must be on nine ounces, 17 penny-weight, 15 grains; the friction sev penny-weight, seven grains. Here the foot of the prop to be 26 inches from the centre.

Exp. 3. If the end of the prop be placed under a poi in the bar; so that the horizontal distance of the foot of t prop be exactly equal to the distance of the centre gravity from the said centre of motion, *viz.* 5. 20, inche the power or pressure sustained by the prop will be precise equal to the weight of the bar, *viz.* 12 ounces, 12 penn weight, 12 grains. In this case the prop is distant from t centre of motion on the bar 9. 17, nine inches, and the frictio four penny-weight, five grains.

Case 3. In which the angle formed by the prop with t horizontal line is given, either acute or obtuse.

As this case is very intricate (on account of the seve powers of the sine and cosine of the given angle, which a multiplied into the prop, and into the weight of the beam) is exemplified only in one experiment; namely, when the an gle

gle, formed by the prop with the horizontal line, contained between the foot of the prop and the centre, is acute; then there is a *maximum* of preſſure, which the Doctor ſhews by experiment to be the very ſame with that given by the calculation. He ſuppoſes the angle formed by the prop and the horizontal line to be 60 degrees: The calculation of this *maximum* ſhews, that if the prop be 10 inches long, the diſtance meaſured upon the bar, to which the upper end of the prop muſt be applied, will be 10 inches $\frac{96}{100}$ parts, the bar itſelf forming then an angle of about 52 degrees, 12 minutes; and the horizontal diſtance between the centre of motion and the foot of the prop is then 11 inches $\frac{72}{100}$ parts.

N. B. Three things are to be remarked in this caſe.

1. That when the angle, made by the prop and horizontal line, contained between the centre of motion and foot of the prop, is acute, as in the laſt experiment, there is always a *maximum*: Whereas if the ſame angle were obtuſe, there would be no poſitive *maximum*: For, then the preſſure would continually increaſe, the nearer the prop is to the centre of motion.

2. That when the angle of the prop with the horizon is acute, as in the laſt experiment, the bar, or long and heavy body, can be rais'd, by applying the power or prop always with the ſame angle to the horizon, quite up to a vertical ſituation.

3. That the firſt caſe, which is when the prop is perpendicular to the horizon, is only a particular caſe of this more general one.

Caſe 4. Is when the angle, made by the prop with that part of the beam, contain'd between the point to which it is applied, and the centre of motion, is given either acute or obtuſe.

As the expreſſion of the power in this caſe is fully as intricate as in the laſt, the Doctor gives only one example or experiment; and for the greater ſatisfaction of thoſe who ſee it, he choſe that wherein the preſſure is in its *maximum*. He ſuppoſes, as before, the angle made by the prop (ſtill 10 inches long) with that part of the beam contained between the point to which it is applied, and the centre of motion, to be acute and of 60 degrees; then the *maximum* of preſſure will be, when the part of the beam intercepted between the centre of motion and the upper end of the prop is 12 inches $\frac{21}{100}$ parts; the bar is then elevated about 50 degrees 13 minutes; and the horizontal diſtance between the centre of motion

motion and the foot of the prop is then 11 inches $\frac{23}{100}$ parts.

N. B. The ſame things are alſo to be remark'd in th
caſe as in the preceding.

1. If the angle made by the prop and the part of the bean
intercepted between the point of application and the centre
motion, be acute, there will always be a *maximum.* Th
contrary, if that angle be obtuſe.

2. If the angle be acute, the bar cannot be rais'd u
to a vertical ſituation by applying the power or prop co
ſtantly with the ſame acute angle; but it may be rais
quite up, if the angle of the prop with the beam be obtuſe

3. The 2d caſe is but a particular caſe of this gener
one.

An Account of the Peruvian *or* Jeſuits Bark; *by* Mr. Willia Arrot. Phil. Tranſ. N° 446. p. 81.

THE tree from which the *Jeſuits Bark* is cut (M *Arrot* himſelf having gather'd it) grows in the kin dom of *Peru*, in the *Spaniſh Weſt-Indies*; and moſt commo ly found in the provinces of *Loxa*, *Ayavaca* and *Quenca*, tuate between two and five degrees of ſouth latitude. Th tree is tall, and has a trunk rather bigger than a man's thig tapering from the root upwards, has no boughs or branch till near its top; and theſe grow as regular as if lopp'd arti cially, and with the leaves form exactly the figure of a hem ſphere: Its bark is of a blackiſh colour on the outſide, a ſometimes mixt with white ſpots, from whence commo grows a kind of moſs, which the *Spaniards* call *barbas*; leaves reſemble much the leaves of our plum-tree, of darkiſh green colour on their upper or concave ſide, and re diſh on their lower or convex ſide; its wood is as hard as c common *Engliſh* aſh, and rather tough than brittle.

There are 4 ſorts of the bark of this tree, to which t *Spaniards* give the following names, *viz. Caſcarilla colora* or reddiſh bark; *amarylla*, yellowiſh; *creſpilla*, curlin and *blanca*, whitiſh: But Mr. *Arrot* could only find 2 dif rent ſorts of the tree; and he believes that the other 2 ſo of the bark are owing to the different climates where it gro and not to a different ſpecies of the tree. The bark call *colorada* and *amarylla* is the beſt, and differs from the *bla* in this, that the trunk of the former is not nigh ſo big that of the latter, the leaves being as deſcrib'd abov Whereas thoſe of the *blanca* are larger, and of a ligh gre

green colour, and its bark has a very thick ſpongy ſubſtance, whitiſh on the outſide, and is ſo tough, that it requires the force of an ax to ſlice it from the tree: It is true, it is as bitter when cut down as the beſt ſort, and has then the ſame effect in intermitting fevers; but when dry and long kept, turns quite inſipid and good for nothing: And it is to be obſerved, that both ſorts have a much ſurer and quicker effect in cures, when green, than when dry. As the bad ſort is in great plenty, and the beſt very ſcarce and hard to be come at, large quantities of it are yearly cut, and ſent with a little of the fine bark to *Panama* for *Europe*.

The tree of the *creſpilla* is the ſame with that of the *amarylla* and *colorada*; but grows in a cold froſty climate: By which means the bark is not only alter'd in its quality, but is alſo whitiſh on the outſide, tho' cinnamon-colour'd within ſide, and in medicines ought to be rejected. This ſort and the *blanca* grow plentifully in the province of *Ayavaca*, 50 leagues from *Piura*, and 62 from *Payta*, a port in the ſouth-ſea; as alſo in *Cariamango*, *Gonſonama* and *Ximburo*, whence they commonly ſend it to *Payta*, and there ſell it as the beſt ſort. The *blanca* likewiſe grows in the province of *Quenca*, and in the mountains of *Caxamarea*: But the true and genuine fine *Jeſuits* bark, which is of a reddiſh or yellowiſh colour, is only found from 5 to about 14 leagues round the city of *Loxa*, in the province of *Loxa*, which the *Spaniards* generally call *provincia de las calvas*. This city is ſituated between two rivers, that run into the great river *Marannon*, or the river of the *Amazons*, and lies about 100 leagues from *Payta*, and in a direct line about 110 leagues ſouth-eaſt from *Guayaquil*, tho' by the common road near 200. The places about *Loxa*, where this fine ſort is found, are, *La Sierra de Caxanuma Malacatos*, *Irutaſinga*, *Yangana*, *Manſanamace*, *La ſierra de Boqueron*, and a place call'd *Las Monſas*.

The bark-trees do not grow altogether in one ſpot, but intermixt here and there with ſeveral others in the woods: It happens, ſometimes indeed, that cluſters of them are found together, tho' at preſent they are much ſcarcer than in former times; a great many of the fine large bark trees having been entirely cut down, that their bark might be the more eaſily ſliced off.

The ſoil, where the beſt ſort thrives, is generally in red clayey or rocky ground, and very frequently on the banks of ſmall rivers deſcending from high mountains.

 That

That this tree flouriſhes and bears fruit at the ſame time a
the year round, is certainly owing to the almoſt uninterrupt
rains that fall in thoſe high mountains where it grows, whi
continue with little or no intermiſſion: Tho' about 3 or
leagues down in the low country, where it is exceſſively h
there are wet and dry ſeaſons, as in other hot countries; t
rains beginning in *December* and ending in *May*: This ſeaſ
the *Spaniards*, who live there, call *temporal*, and it is gener
all thereabouts; whereas what they call *paroma* is a cold rai
ſeaſon, that laſts in all the mountainous places of theſe cou
tries from *June* to *November*, but eſpecially in the city of *Lo*
and places adjoining, where Mr. *Arrot* had paſs'd 25 or
days without ſeeing the ſun once; and felt the air ſo exceedi
cold, that he was obliged to be always wrapped up in his cloa
and to be in continual motion to keep himſelf warm. Su
exceſſive cold ſo near the line appears to *Europeans* incredibl
but many places in theſe latitudes are ſo, by their ſituation a
vicinity to high mountains.

The propereſt ſeaſon for cutting the bark is from *Septemb*
to *November*, the only time in the whole year that there
ſome intermiſſion from rain in the mountains. Having diſc
ver'd a ſpot where the trees moſt abound, they firſt build hu
for the workmen, and then a large hut in which to put t
bark, in order to preſerve it from the wet: But they let it l
there as ſhort a time as poſſible, having before-hand cut a ro
from the place where the trees grow, thro' the woods, ſometim
3 or 4 leagues, to the neareſt plantation or farm-houſe in t
low country, whither, if the rain permit them, they carry t
bark forthwith to dry. Theſe preparations made, they pr
vide each *Indian* (they being the cutters) with a large kni
and a bag that can hold about 50 pounds of green bark: Eve
two *Indians* take one tree, whence they cut or ſlice down t
bark, as far as they can reach from the ground; they then ta
ſticks about half a yard long each, which they tie to the tr
with tough withs at proper diſtances like the ſteps of a ladde
always ſlicing off the bark, as far as they can reach, befo
they fix a new ſtep, and thus mount to the top, the *Indian* b
low gathering what the other cuts; this they do by turns, a
go from tree to tree, till their bag is full; which, when th
have plenty of trees, is generally a day's work for one *India*
As much care as poſſible muſt be taken that the bark be not c
wet; ſhould it ſo happen, it muſt be carried directly down t
the low country to dry: For, otherwiſe it loſes its colour, tur

blac

black and rots; and if it lie any time in the hut without being spread abroad, it runs the same risque: So that while the *Indians* are cutting, the muscles (if the weather permits) ought to be carrying it down to the place appointed for drying it; which is done by spreading it abroad in the open air, and frequently turning it.

Mr. *Arrot* had the curiosity to send upwards of 50 seroons from the woods to the city of *Loxa*, where he put it into a large open house, and dried it under cover, never exposing it either to the sun or night air, imagining that the sun exhal'd a great many of its fine parts; and that the night air, or *serene*, was very noxious to it: But he found the colour of the bark, thus cur'd, not near so bright and lively as that dried in the open air. He is of opinion that a very short time will put an end to this best sort, or at least, that it will be extremely hard to be got, by reason of its distance from any inhabited place, the impenetrability of the woods where it grows, and the scarcity of the *Indians* to cut it, who, by the *Spaniards* hard usage and cruelty, are daily diminishing so fast, that in a very few years their race in that country shall be quite extinct.

Mr. *Arrot* says, that the small bark which curls up like sticks of cinnamon (and which in *England* is much valued, as being cut off the branches; and therefore reckon'd better and more effectual in curing fevers) is only the bark of the younger trees; which, as it is very thin, curls in that manner; and that the bark of the branches would not compensate the trouble and expences of cutting. He likewise affirms, that after the bark is cut off any tree it requires at least 18 or 20 years to grow again; which is directly contrary to what Dr. *Oliver* says in *Phil. Trans.* N° 290. He added besides, that its fruit is no ways like a chesnut, as the Dr. informs us in the same *Transaction*; but rather like a pod, which incloses a seed somewhat like a hop-seed; and that he had sent some of them to *England*.

He could not tell by what artifice or stratagem the *Jesuits* had got this bark to be call'd after them, if not that they carried it first into *Europe*, and gave themselves out as the first discoverers of its virtues: But Mr. *Arrot* assured, that the current opinion at *Loxa* is, that its qualities and use were known to the *Indians* before ever any *Spaniard* came among them; and that it was by them applied in the cure of intermitting fevers, which are frequent over all that wet unhealthy country.

Observation of the Moon's *transit by* Aldebaran, *at* Lond
April 3, 1736; *by Dr.* Bevis. Phil. Transf. N° 446. p. 90

Fig. 17. Plate IX. the glass inverting the objects.

Apparent time. H.	M.	S.	
7	40	0	The moon's body and *Aldebaran* seen together i the distinct base of the telescope.
7	45	52	The moon's southern limb running along the paral lel thread; the western limb came to the horar thread.
7	49	41	The glass remaining fixt, and *Aldebaran* runnin along the parallel thread (having the same de clination with the moon's southern limb) came t the intersection of the threads.
8	13	4	The moon again running along the parallel came t the horary thread.
8	15	50	*Aldebaran* (the telescope remaining fixt) came t the first oblique thread at *c*.
8	15	54 ½	— to the horary thread at *b*.
8	15	59	— to the second oblique thread at *a*.
8	59	54	*Aldebaran* in the line passing thro' the cusps, hi nearest distance from the moon's body being some what less than the length of *Mare Crisium*, o $\frac{1}{10}$ of the moon's diameter nearly.

Fig. 18. represents the visible way of the moon.

A lunar Eclipse *observ'd in* Fleet-street, London, Sept. 8, 1736 *by Mr.* George Graham, *and Mr.* James Short *of* Edinburgh. Phil. Transf. N° 446. p. 92.

September 8, 1736	Apparent time. H.	M.	S.
Beginning of the eclipse	12	58	0
The shadow touch'd *Grimaldi*	13	0	0
—— *Kepler*		9	30
—— *Copernicus*		17	10
—— the east side of *Tycho*		25	5
—— the east side of *Plato*		34	30
—— the east side of *Manilius*		36	40
—— the east side of *Mare Crisium*		56	20
Beginning of total darkness	14	3	45

The

The obſervation was made with a 5 $\frac{1}{2}$ inches reflecting teleſcope, magnifying about 38 times.

A total Eclipſe of the Moon *obſerv'd* Sept. 8, 1736, O. S. *in* Covent-Garden, London; *by Dr.* Bevis. Phil. Tranſ. N° 446. p. 93. *Tranſlated from the* Latin.

The obſervation was made with a 5 foot teleſcope.

Apparent time H.	M.	S.	
12	53	25	The *penumbra* tinges the north-eaſt limb of the moon: The ſky ſerene.
	54	25	The *penumbra* now pretty ſenſible: Serene.
	56	50	The true ſhadow, as far as the Dr. could judge, touches the moon's limb: Serene.
	57	30	The ſhadow touches *Grimaldi*; ſerene.
13	00	25	The ſhadow covers *Grimaldi*: The ſky pretty ſerene.
	7	23	It enters *Mare humorum*; obſerv'd thro' thin clouds: Afterwards the clouds became very thick.
	28	39	The ſhadow touches *Mare vaporum*: Serene.
	31	19	The darken'd part of the moon is ſeen of a reddiſh colour, as it were: The ſky exceeding ſerene.
	36	53	The limit of the ſhadow biſſects *Manilius*, and touches *Mare ſerenitatis*. Exceeding ſerene.
	38	48	It touches *Mare tranquillitatis*: Serene.
	47	21	*Mare ſerenitatis* cover'd: Serene.
	55	26	The ſhadow touches *Mare Criſium*: Serene.
	58	5	*Mare fœcunditatis* cover'd: Serene.
14	2	25	The total immerſion of the moon.
			Very thick clouds come on; and the moon is no longer ſeen, till
16	43	0	*Mare tranquillitatis*, as it appears, entirely emerged — thro' the breaks of the clouds.
	43	30	Clouds again.
17	3	22	The cloud going off, the moon ſeem'd entirely clear.

The clock was adjuſted to true time by equal altitudes of the Sun, and its agreeing with Mr. *Graham*'s was mark'd, by means of a very good pocket-watch.

A

A total Eclipse *of the* Moon *observed at* Wittemberg *in* Saxony, September 8, 1736, O. S. *in the Morning*; *by* M. Weidler. Phil. Trans. N° 446. p. 94. *Translated from the* Latin.

H.	M.	S.	
1	36	0	The *penumbra* comes on the eastern part of th moon like a smoke or fog.
1	50	0	The beginning.
1	50	30	The shadow comes to *Grimaldi*.
1	52	0	——— touches *Galilæus*.
2	0	0	——— *Kepler*.
2	1	30	*Kepler* entirely cover'd.
2	7	0	The portion of the moon's disk, that is deeper im mersed in the shadow, appears brighter than tha nearer the edge of the shadow.
2	8	0	The shadow comes to *Copernicus*.
	10	50	——— entirely covers *Copernicus*.
	16	10	The shadow comes to *Tycho*.
	20	0	Half the moon obscur'd.
	25	0	The shadow comes to *Mare serenitatis*.
	29	10	——— to *Menelaus*.
	36	0	*Mare serenitatis* entirely cover'd. At this time the moon appears red thro' the sh dow like a live-coal.
	45	30	The shadow comes to *Mare Crisium*. At this time the edge of the shadow about *Ma Crisium* is inwardly incurvated. And all the time of the eclipse the periphery the shadow is rough and distinguished by sever prominences; and in the extremity it is seen e compassed as with a thin smoke.
	50	0	*Mare Crisium* entirely cover'd.
	53	0	Total obscuration. At this time about a third part of the moon's di towards the east appears darker than the weste part.
3	43	0	The shadow appears denser in the middle, a more dilute towards the extremities.
4	8	0	The moon is cover'd with clouds.
4	44	0	The emersion of the moon out of the shadow.
4	45	0	The shadow goes off *Grimaldi*.

Clouds afterwards hid the moon; and tho' ſhe emerged again out of them, yet a fog or rarer cloud darkens her in ſuch manner, that the *maculæ* could not be diſtinguiſh'd: At length the moon is entirely hid by denſer clouds.

The obſervation was made with a teleſcope of 8 *Paris* feet.

A lunar Eclipſe *obſerv'd* Sept. 8, 1736, *in* Hudſon's-bay; *by Capt.* Chriſtopher Middleton. Phil. Tranſ. N° 446. p. 96.

CAPT. *Middleton*, being in *Hudſon's-bay* (in Lat. 55 degrees, 34 minutes, north, and on the meridian of the *north bear iſland*, which lies 30 miles to the weſtward of *Charlton*) obſerved a total eclipſe of the moon on *Sept.* 8, 1736: The weather was very clear; but the motion of the ſea render'd his teleſcope uſeleſs, and he miſs'd the beginning.

	H.	M.	
The total immerſion of the moon's body into the ſhadow. — —	8	22	by his watch
The emerſion — — —	10	8	by ditto
The end — — —	11	16	by ditto

In order to rectify his watch, and be ſure of the true time, he took 3 ſeveral altitudes next morning, and one in the afternoon, by Mr. *Hadley*'s and Mr. *Smith*'s quadrants; which (having made proper allowances for the refraction of the atmoſphere and the height he ſtood above the ſurface of the ſea) were, as follows,

	Deg.	Min.		H.	M.
Firſt altitude	23	0	hence the true time	8	49 —
Latitude	55	45	the time by the watch	8	28
			Watch too ſlow	0	21 —

Deg.

	Deg.	Min.		H.	Min.
Second altitude	25	48	The true time therefore, is	9	15
Latitude	55	45	The time by the watch	8	54
			Watch too slow	0	21
Third altitude	26	44	The true time, therefore, is	9	24
Latitude	55	45	The time by the watch	9	3
			Watch too slow	0	21
The fourth altitude taken the same day in the afternoon	21	29	Hence the true time is	3	25
Latitude	55	33	The time by the watch	3	04
			Watch too slow	0	21

If, therefore, 21 minutes be added to the times above-men tion'd for the error of the watch, we shall have the true tim of the several observations on the meridian of the *north-bea island*, as follows, *viz.*

	H.	M
The total immersion of the moon's body into the shadow — — — — —	8	
The emersion — — — —	10	
The end — — — —	11	

This same eclipse was observ'd *Sept.* 8, 1738. by Dr. *Bev* at *London*; and he made the true time of the total immersi of the moon's body into the shadow, 14 hours, 2 minutes, seconds; consequently, the difference of longitude betwe *London* and *North bear-island* in *Hudson's bay* is 5 hours, minutes, 25 seconds, or 79 degrees, 51 minutes.

A solar eclipse observed at London, Sept. 23, 1736; *By Dr.* Bevis. Phil. Transf. N°. 446. p. 98. *Translated from the* Latin.

App. time, P. M.

H. M.	S.	
4 12	35	The northern limb of the sun (Fig. 19. Plate IX.) running along the parallel thread P. P. his western limb touches the horary thread H. H.
12	42	The little macula near the northern limb comes to the first oblique thread 1.
13	1	The macula at the horary thread H. H.
13	20	The macula at the second oblique thread 2.
14	45	The eastern limb of the sun at the horary thread: afterwards clouds.
45	41	The sun emerging out of the clouds; the eclipse, it is true, is begun by the telescope, but now scarcely seen begun.
45	48	It is still imperceptible to the naked eye through a colour'd glass.
46	0	Now it is pretty sensible. Then clouds.
5	29	The southern limb (Fig. 20.) running along the parallel, the western limb at the horary thread.
5	41	The western cusp of the sun at the horary thread.
7	5	The eastern cusp at the horary thread.
7	39	The eastern limb at the horary thread.

Then the sun is overcast with clouds till its setting.

The Dr. puts the beginning at 4 h. 45 m. 31 sec. p. m.

An occultation of Mars *by the* Moon, *observed in* Fleet-street, London, Oct. 7, 1736, *by Mr.* Greorge Graham. Phil. Transf. N°. 446. p. 100.

THE observation was made with a refracting telescope of 12 foot.

Apparent time.

H.	M.	S.	
14	24	44	*Mars* appeared above half covered; but a distinct view could not be had for flying clouds.
14	25	21	*Mars* entirely covered, the last ray of light being then lost.

Apparent time.			
H.	M.	S.	
15	11	22	The moon appeared, but *Mars* was not seen, no part being yet emerged.
15	15	11	He judged it was quite emerged; but clouds hindered the moon's limb from being distinctly seen.

The same observed in Covent-Garden, London, Oct. 7, 1736. *by Dr.* Bevis. Phil Transf. N°. 446. p. 101.

BEFORE the eclipse, Dr. *Bevis* took several differences of right ascension and declination between *Mars* and μ of *Pisces*, for ascertaining the true place of that planet.

App. time, P. M.			
H.	M.	S.	
14	24	10	The Dr. was surprized to see *Mars* continue qui[te] round, tho' hardly, to appearance, disjoin[ed] from the scabrous edge of the moon: But th[e] instant he thought it began to lose its figure. Clouds.
14	25	26	The moon shone out bright again; but *Mars* e[n]tirely vanished.
15	14	46	The moon being just clear of a cloud, he sa[w] *Mars* partly emerged.
15	14	49	*Mars* seemed just half out: Then clouds agai[n], so that he did not see the final contact.

The moon's diameter was 21,157 parts of t[he] micrometer; and its illuminated part pass[ed] over the horary thread in 2 m. 3 sec.

The Dr. is certain of the time to 2 or 3 sec.

A Transit of Mercury *over the* Sun, *observed in* Fleet-stre[et], London, Oct. 31, 1736. *by Mr.* George Graham. Ph[il.] Transf. N°. 446. p. 102.

App. time, A. M.				
	H.	M.	S.	
At	9	22	0	*Mercury* not yet seen; then clouds.
		25	37	Mr. *Graham* first saw *Mercury* for a few [se]conds; and judged he was got intirely with[in] the sun's disk, or perhaps a little mor[e]. Then clouds again, with some intervals o[f a] few moments between, which allowed a sig[ht] of *Mercury* about three or four several tim[es] th[...]

App. time, A. M.
H. M. S.

then quite cloudy till near 12, when he had a ſight of the ſun for a few minutes, and took his tranſit upon the meridian; at which time *Mercury* was judged to be about two of his diameters, or a little more, within the ſun's diſk, and a little paſt the vertical line.

12 10 27 He had again a ſight of the ſun, but *Mercury* was gone off.

A Tranſit of Mercury *over the* Sun, *at the Obſervatory of* Bononia, Nov. 9, 1736, N. S. *in the morning*; *by* S. Manfredi. Phil. Tranſ. N°. 446. p. 103. *Tranſlated from the* Latin.

IN the higheſt room of the obſervatory, S. *Zanotti* directed towards the ſun a very good teleſcope of *Campani*'s, of 22 *Bononian* feet in length, to obſerve, if poſſible, the very ingreſs of *Mercury* on the ſun's limb; and others from other parts of the obſervatory directed ſhorter teleſcopes for the ſame purpoſe. The ſky was very clear; and there was not a breath of wind ſtirring. S. *Roverſius* had the good fortune firſt of all to diſcover the planet at the ſun's limb at $22^h\ 8'\ 37''$ p. m. and immediately determine his interior contact with the ſun at $22^h\ 11'\ 12''$. The clocks were adjuſted for the ſame days to the meridian line, which *Zanotti* had ſeveral times compared with the ſun by equal altitudes morning and evening.

Other obſervers found the planet ſomewhat later on the ſun's limb; and S. *Manfredi*, directing from a lower room an 11 foot teleſcope of *Campani*'s, did not ſee the planet before $22^h\ 9'\ 5''$; when now it touched the ſun with a pretty conſiderable part of its body; but its interior contact by the ſame teleſcope was at $22^h\ 10'\ 53''$. But the former obſervation is much more certain, as having been taken with a better inſtrument; yet ſince it appeared from the times of the planet's going off, as ſhall be mentioned anon, that it ſpent therein $3'\ 16''$, if we ſubſtract ſo much from the time of interior contact obſerved by *Roverſius*, the exterior contact, or the firſt appulſe of *Mercury* to the ſun will be ſtill more certain, namely $22^h\ 7'\ 56''$.

Afterwards the obſervations were made with a view to find ſome points of the viſible path of the planet on the ſun's diſk: All theſe points were referred to the horary circle, as alſo to the parallel drawn thro' the ſun's centre, according to *Caſſini*'s Me-

thod, marking the times by a clock, in which the sun's limb and *Mercury* passed the horary thread of the micrometer: And the latter besides passed the oblique threads, whilst the sun with his northern limb grased along the parallel thread itself. With an eight foot telescope *Zanotti* found a great many such points; and S. *Manfredi* one or two, with a six foot telescope, fitted with an exquisite micrometer, invented by the celebrated S. *Marinonius*, *Cesarean*-Mathematician, and presented by him to this observatory. With the same telescope both S. *Roversius* and Dr. *Perelli* determined some other points. And to this likewise is referable the observation made by the latter in the meridian, with a mural semicircle, whereby the right ascension of the planet was found greater by 11 seconds of time and $\frac{2}{3}$; and its declination less by 58 seconds and $\frac{1}{2}$ than that of the sun's centre. Besides, *Zanotti* took upon himself to describe the positions of the more remarkable maculæ, which were seen in great numbers that day on the sun. It was easy to distinguish the planet from these maculæ, both as it was exactly round, and very black, and surrounded with no *areola*.

As to *Mercury*'s egress, S. *Algarotti*, who came to *Bononia* in order to view this phænomenon, observed with an eight foot telescope the beginning at 50 min. 1 sec. p. m. the end at 53 min. 6 sec. But S. *Manfredi* with the 11 foot telescope above mentioned observed the beginning at 51 min. 7 sec. and the end at 53 min. 44 sec. *Roversius* with a 14 foot telescope only observed the end at 54 min. 1 sec. But these observations are less certain, both as the telescopes were but indifferent, and as a wind arising at that time disturbed them a little. Therefore the observation with the 22 foot telescope, whereby S. *Franciscus Vandelius* determined the interior contact at 50′ 50″ and the exterior at 54′ 6″, is to be preferred to all the others: Whence the *mora* of the planet on the sun's limb was 3′ 16″, and the time of the egress of the centre 52′ 28″, which according to S. *Manfredi*'s observation should be 52′ 25″.

Thus far the observations themselves: Now S. *Manfredi* comes to what may be deduced from comparing them together. Assuming the sun's diameter 32 min. 34 sec. and the time of his transit over the horary circles 2 min. 17 sec. (which numbers are exhibited in the tables of modern astronomers, and verified by the observations themselves) the points of the planetary path defined by observation are represented Fig. 21. Plate IX. And since by reason of the small errors in the observations all the points did not exactly

fall into the ſame right line, there was no fitter way of reconciling them than by ſuppoſing a perpendicular drawn from the centre of the ſun to the path of the planet to form an angle with the horary circle of 23 degrees, 40 min. to the eaſt; and put the length of that perpendicular from the centre to the path itſelf 13 min. 58″ to the north. From theſe all the reſt was calculated as follows:

	H.	′	″
The beginning of mercury's ingreſs upon the ſun's diſk	22	7	56
The ingreſs of the centre	22	9	34
The total ingreſs	22	11	12
The beginning of the egreſs	0	50	50
The egreſs of the centre	0	52	28
The total egreſs	0	54	6
The *Mora* of mercury's centre on the ſun's diſk	2	42	54
The *Semi-mora*	1	21	27
The time of the mean tranſit	23	31	1

	Deg.	Min.	Sec
The angle of the perpendicular to the path of the planet with the horary circle, determin'd by the obſervations to the eaſt.	23	40	0
The angle of the eclip. with the horary circle from aſtronomical tables to the eaſt	105	48	0
Thence the angle of the ecliptic with the perpendicular to the apparent path of mercury	82	8	8
And the angle of the apparent path with the ecliptic	7	52	0
The diſtance of the path from the centre of the ſun found by the obſervations to the north	0	13	58
The ſun's ſemi diameter	0	16	17
The length of the path within the ſun's diſk	0	16	45
The half of that length	0	8	22

From

	H.	′	″
From these the horary motion of mercury in the apparent path	0	6	[illegible]
The apparent horary motion in the ecliptic	0	6	[illegible]
Hence the portion of the path between the middle of the transit and the conjunction	0	1	[illegible]
The portion of the path from the ingress till the conjunction	0	10	[illegible]
The portion of the same from the conjunction till the egress	0	6	[illegible]
The difference of the longitude of mercury and the sun in the ingress	0	10	[illegible]
The difference of longitude in the egress	0	6	[illegible]

	H.	′	″
The time from the middle of the transit till the conjunction	0	19	[illegible]
The very time of the conjunction at *Bononia* true time	23	50	[illegible]
mean time	23	34	[illegible]
The longitude of the sun and mercury in the very conjunction according to *Cassini*'s tables	° 19 of scorpio	′ 23	[illegible]

With this longitude corresponds within four seconds [illegible] observation made the same day by S. *Peter Lilius* with [illegible] meridian gnomon at S. *Petronio*'s church.

	°	′	″
The latitude of mercury in the ingress north	0	12	[illegible]
Lat. in the egress north.	0	14	[illegible]
Thence the horary motion in lat.	0	0	[illegible]
And the lat. in the very conjunction north	0	14	[illegible]

	H.	′	″
Hence the interval of time from the transit of mercury thro' the ascending node till the conjunction	16	39	[illegible]
The very time of the transit thro' the node true time	7	11	[illegible]
mean time	6	55	[illegible]

	Deg.	′	″
According to *Cassini*'s tables, the motion of mercury in his orbit, seen from the sun in the space of 16^h 39′ about this time, or the argument of latitude in the conjunction	4	15	47
The same motion reduced to the ecliptic	4	13	56
Thence the place of the ascending node of mercury seen from the sun	15	9	34
	of Taurus		
The distance of mercury from the sun at the time of conjunction according to *Cassini*'s tables	Log. 449301		
The distance of the earth from the sun according to the same tables	Log. 499503		

	Deg.	′	″
Hence the N. latitude of mercury at the time of conjunction, seen from the sun	0	30	31
	0	′	″
Whence the inclination of mercury's orbit to the ecliptic	6	51	0

	H	′	″
The time from the interior to the exterior contact of mercury at his going off, by observation	0	3	16
The portion of the path run over by mercury in this time.	0	0	20
	0	′	″
The angle of the path with the sun's semidiameter in the egress	58	50	0
Thence the apparent diameter of mercury very nearly.	0	0	10

The transit of Mercury *over the* Sun, Nov. 11. 1736. N. S. *observed by* M. Weidler. Phil. Transf. N° 446. p. 110.

THO' the uncertain state of the weather was some hindrance to a compleat observation of the transit of mercury over the sun, *Nov.* 11. 1736. N. S. Yet what M. *Weidler* observ'd, he thought proper not to deprive others of; chiefly because it did not appear to him, that this phenomenon had hitherto been observ'd with better success.

Mercury appeared within the sun's eastern limb, as represented, Fig. 22. Plate IX.

H.	M.	S.		
10	49	20	at	1
11	36	0	mercury about	2
11	52	20	at	3
12	2	30		4
12	4	30		5
	44	20		6
	52	45		7

Obſervations made at Oxford *on the Comet that appeared i* January, February, *and* March, 1737; *by Mr.* James Brad-ley. Phil. Tranſ. N° 446. p. 111.

MR. *Bradley* made ſeveral obſervations on the late Co-met, during the laſt five weeks of its appearanc which enabled him to find out the elements of a parabol trajectory, upon which a calculus might be founded tha would correſpond with each of his obſervations within abou a minute of a degree: But the firſt of them being take many days after the time of the *perihelion*, and the whole ſe-ries comprehending but a ſmall portion of the trajectory; h was ſenſible that a little error, either in the obſervation themſelves, or in the places of the fixt ſtars, with which th comet was compar'd, might occaſion a conſiderable differenc in the ſituation and magnitude, &c. of the orbit, deduced fro them alone: And therefore he was deſirous of having ſom earlier and accurate obſervations, in order to determine thoſ elements with more certainty: But not having hitherto bee able to procure ſuch, he now communicates the particula of his own, together with the compariſon between the ob-ſerved places of the comet, and thoſe computed from ſuch ele-ments as he has already collected from his own obſerva-tions.

He firſt ſaw the comet on the 15th of *February*, 1737, be-tween ſix and ſeven in the evening, when its nucleus appear' ſmall and indiſtinct; and its tail (extending above a degre from the body) pointed towards the ſtar *in lino auſtral.* o *Piſces*, mark'd ξ by *Bayer*. Upon applying his microme-ter to a good ſeven foot teleſcope, he obſerv'd, that at ſeve hours, 32 min. equat. time, the comet preceded the ſaid ſta one degree, one minute, 40 ſeconds in right aſcenſion, and wa 20 minutes, 20 ſeconds, more ſoutherly than the ſtar.

Note, That the equal time is likewiſe made uſe of in al the following obſervations.

Aſſu-

Aſſuming the place of this ſtar, as ſettled in the *Britiſh Catal.* (as Mr. *Bradley* likewiſe does the places of others hereafter mention'd) it follows, that the comet's right aſcenſion was 23 degrees, 58 minutes; and its declination 1 deg. 31 min. 55 ſeconds north.

February 17. 7 hours, 33 min. the comet follow'd *α in nodo lini Piſcium* 31 min. 25 ſeconds in *Right Aſcenſion*; and was 52 min. 30 ſeconds more northerly: Hence the comet's *Right Aſcenſion* was 27 deg. 38 min. 20 ſeconds; and its declination 2 deg. 21 min. 10 ſec. north.

February 18. 7 hours 14 min. a ſmall ſtar (whoſe *Right Aſcenſion* was afterwards found to be 29 deg. 5 ſeconds; and declination 2 deg. 58 min. 30 ſec. north) preceded the comet 24 min. in *Right Aſcenſion*; and was 15 min. 30 ſec. more northerly. Hence the comet's *Right Aſcenſion* was 29 deg. 24 min. 5 ſec. and its declination 2 deg. 34 min. north.

February 21. 7 hours, 25 min. the comet preceded *ν Ceti* 1 deg. 6 min. in *Right Aſcenſion*; and was 38 min. 20 ſec. more ſoutherly. Hence the comet's *Right Aſcenſion* was 34 deg. 25 min. 10 ſec. and its declination 3 deg. 47 min. 20 ſec. north.

Feb. 22. 7 hours, 45 min. the comet follow'd *ν Ceti* 30 min. 5 ſec. in *Right Aſcenſion*; and was 18 min. 45 ſec. more ſoutherly: Hence the comet's *Right Aſcenſion* was 36 deg. 1 min. 15 ſec. and its declination 4 deg. 6 min. 55 ſec. north.

Feb. 25. 7 hours 45 min. a ſmall ſtar (whoſe *Right Aſcenſion* was afterwards found to be 40 deg. 34 min. and declination 5 deg. 5 min. 30 ſec. north) follow'd the comet 2 min. 30 ſec. in *Right Aſcenſion*; and was 2 min. 30 ſec. more northerly than the comet: Hence the comet's *Right Aſcenſion* was 40 deg. 31 min. 30 ſec. and its declination 5 deg. 3 min. north.

The difference of *Right Aſcenſion* and declination between this ſtar and the comet was taken with a fifteen foot teleſcope; but the place of the ſtar was determin'd by one obſervation made with the 7 foot teleſcope.

Feb. 27. 8 hours 45 min. the comet preceded a ſmall ſtar 1 deg. 16 min. in *Right Aſcenſion*; and was 2 min. 15 ſec. more ſoutherly. The *Right Aſcenſion* of this ſtar was afterwards (by a ſingle obſervation) found to be 44 deg. 37 min. 40 ſec. and its declination 5 deg. 38 min. 30 ſec. north: Hence the comet's *Right Aſcenſion* 43 deg. 21 min. 40 ſec. and its declination 5 deg. 36 min. 15 ſec. north.

Mar. 4. 8 hours a small star (whose *Right Ascension* wa found to be 49 deg. 30 min. 30 sec. and its declination 6 de 38 min. 30 sec. north) preceded the comet 7 min. 30 sec. i *Right Ascension*; and was 10 min. more southerly: Hence th *Right Ascension* of the comet was 49 deg. 38 min. and its de clination 6 deg. 48 min. 30 sec.

Mar. 12. 8 hours 25 min. the comet preceded μ of *Taur* 2 deg. 5 min. 50 sec. in *Right Ascension*; and was 4 mi 25 sec. more northerly than the star: Hence the comet's *Rig* *Ascension* was 58 deg. 12 min. 40 sec. and its declination 8 de 16 min. 50 sec. north.

Mar. 14. 9 hours the comet follow'd the 47th star of *Taur* in *Brit. Catal.* 12 min. 50 sec. in *Right Ascension* and w 15 sec. more northerly than the star: Hence the comet's *Rig* *Ascension* was 60 deg. 8 min. 5 sec. and its declination 8 de 34 min. 5 sec. north. This and all the following observatio were made with a good 15 foot telescope; the comet now a pearing too faint to be well observ'd with the 7 foot telescope.

Mar. 17. 8 hours 40 min. the comet follow'd γ of *Taur* 25 min. 5. sec. in *Right Ascension*; and was 9 min. 40 s more northerly: Hence its *Right Ascension* was 62 deg. 47 m 55 sec. and its declination 8 deg. 58 min. 45 sec. north.

Mar. 19. 7 hours 50 min. the comet follow'd the same s 2 deg. 4 min. 50. sec. in *Right Ascension*, being 23 min. 55 s more northerly: Hence its *Right Ascension* was 64 d 27 min. 40 sec. and declination 9 deg. 13 min. north.

The same night at 9 hours the comet preceded *d* of *Taur* 47 min. 40 sec. in *Right Ascension*; and was 22 min. 50 se more southerly: Hence its *Right Ascension* was 64 deg. 30 mi 20 sec. and declination 9 deg. 12 min. 35 sec. north.

Mar. 20. 8 hours 5 min. the comet preceded *d* of *Tau* 30 sec. in *Right Ascension*; and was 16 min. 35 sec. more so therly than the star: Hence its *Right Ascension* was 65 d 17 min. 30 sec. and declination 9 deg. 18 min. 50 sec. north.

Mar. 22. 8 hours 15 min. the comet follow'd the same s 1 deg. 36 min. 10 sec. in *Right Ascension*; and was 3 m 50 sec. more southerly: Hence its *Right Ascension* was 66 d 54 min. 10 sec. and declination 9 deg. 31 min. 35 sec. north.

This was the last night Mr. *Bradley* saw the comet: For, t moon, being then in her increase, entirely obstructed its fart appearance. The light of the comet was indeed (even in t moon's absence) so very weak, that he found it difficult in so of the latter observations, to take its place with any tolera certain-

certainty; which is, in part, the cause of some little disagreement observable in the comet's places, taken from the same stars on different nights; tho' there are likewise other irregularities that occur in this series of observations, which seem to arise from small errors in the assumed places of the fixt stars.

Supposing the trajectory describ'd by this comet to be nearly parabolical, conformable to what Sir *Isaac Newton* has deliver'd in the third book of his *Princip. Mathem.* Mr. *Bradley* gathers from the foregoing observations, that the motion of this comet in its own orbit was direct; and that it was in its perihelion *Jan.* 19. 8 hours 20 min. equat. time at *London*. That the inclination of the plane of the trajectory to the ecliptic was 18 deg. 20 min. 45 sec. The place of the descending node 16 deg. 22 min. of *Taurus*. The place of the perihelion 25 deg. 55 min. of *Aquarius*. The distance of the perihelion from the descending node 80 deg. 27 min. The logarithm of the perihelion distance from the sun 9.347960. The logarithm of the diurnal motion 0.938188.

From these elements (by the help of Dr. *Halley*'s general table for comets, to which they are adapted) Mr. *Bradley* computed the places in the following table; which also contains the longitudes and latitudes of the comet, calculated from the observ'd *Right Ascensions* and declinations above-mention'd, together with the differences between the observed and computed places.

equat. time at *Oxford*.			observed long. of the comet.			South. Lat. observ'd.		
D.	H.	M.	D.	M.	S.	D.	M.	S.
Feb. 15	7	32	♈ 22	45	7	7	53	27
17	7	33	26	30	30	8	27	21
18	7	14	28	18	14	8	44	20
21	7	25	♉ 3	26	34	9	26	50
22	7	45	5	4	53	9	40	00
25	7	45	9	42	18	10	12	21
27	8	45	12	36	43	10	31	42
Mar. 4	8	00	19	3	00	11	6	46
12	8	25	27	49	58	11	43	3
14	9	00	29	47	42	11	49	59
17	8	40	♊ 2	30	57	11	56	31
19	7	50	4	12	36	12	00	19
	9	00	4	15	11	12	1	12
20	8	5	5	3	10	12	3	5
22	8	15	6	41	30	12	6	15

computed Long. of the comet.			S. Lat. computed.			Diff. of Long.		Diff. of Lat.	
D.	M.	S.	D.	M.	S.		S.		S.
♈ 22	45	00	7	53	1	+	7	+	26
26	30	44	8	28	6	−	14	−	45
28	17	46	8	43	57	+	28	+	23
♉ 3	26	53	9	26	46	−	19	+	4
5	5	28	9	39	27	−	35	+	33
9	41	19	10	12	22	+	59	−	1
12	36	16	10	31	13	+	27	+	29
19	3	5	11	7	8	−	5	−	22
27	49	53	11	43	19	+	5	−	16
29	47	19	11	49	26	+	23	+	33
♊ 2	30	50	11	56	49	+	7	−	18
4	12	45	12	00	47	−	9	−	28
4	15	13	12	00	52	−	2	+	20
5	3	32	12	2	33	−	22	+	32
6	41	19	12	5	42	+	11	+	33

From the small differences between the comet's observ'd and computed places, exhibited in the two last columns of this ta-

ble,

ble, we may reasonably conclude, that the orbit, as above determin'd, cannot differ much from the truth, and must therefore be near enough to enable future astronomers to distinguish this comet upon another return, and thereby settle its period; which Mr. *Bradley* could not then pretend to do, not having met with an account of any former comet that seemed likely to have been the same with this, of which a description has been given particular enough to determine this point.

A Comet *observed in* February, 1737, *from the* Aventine-hill *at* Rome; *by the* Abbè de Revillas. Phil. Transf. N° 446. p. 118. *Translated from the* Latin.

ON the 16. of *February*, 1737, about 7 o'clock *p. m.* the comet appear'd for the first time in the western part of the heavens, 8 or 9 degrees lower than *Venus*, and declining a little towards the south from her vertical circle. With the naked eye nothing was observed but a small whitish line, that shone with a faint light; yet with a very good telescope of *Campani's*, of 6 foot, besides the tail, which extended to the opposite part from the sun, and appear'd like a small line without the telescope, was likewise espied the *nucleus*, tho' encompassed all round with a thin atmosphere. As there was then no quadrant at hand, and not only a fog intercepted, but the twilight deprived the view of the neighbouring fixt stars, the apparent place of the comet could not be determined for that night.

From the 16. till the 19. as also after the 25. there happen'd other impediments, which hinder'd making observations. Moreover, in the nights between the 19. and 26, the Abbè could not otherways determine the apparent place of the comet than by comparing the phenomenon with *Venus*; in regard he only employed a small quadrant, whose tube was scarce an *English* foot in length. From the vertical altitudes, therefore, both of the comet and *Venus* observed at the same time, were collected the vertical differences of both, as follows.

D.	H.	M. *p. m.*	Vert. Differ. Deg.	M.
20	7	59	5	22
22	7	0	3	56
23	7	20	3	13
24	6	15	2	30
25	7	30	1	47

On

On the 22d the tail of the comet passed along the verti[cal] thread of the micrometer in 1 minute, 7 sec. of time. T[he] micrometer was fitted to the above telescope of *Campani*.

D.	H.	M.		Deg.
24	8	3	*Venus* and the comet appear'd under an angle of	7
25	7	50	They appear'd under an angle of	8

Observations on the Comet *seen in* January *and* Febru[ary] 1736-7; *and an* Eclipse *of the* Sun, Feb. 18, 1736-7 [at] Philadelphia *in* Pensylvania; *by Dr.* Kearsly. Phil. Tra[ns.] N° 446. p. 119.

ON the 27. of *Jan.* 1736-7, about 6 in the evening, [Dr.] *Kearsly* observ'd a dull star about 3 or 4 degrees ab[ove] *Mercury*, and a little to the southward of a vertical pass[ing] thro' that planet; but he took little notice of it then, not thi[nk]ing of a comet: But by comparing *Mercury*'s place with [the] fixt stars, he afterwards thought it might be a comet.

On the 31. about 6 hours 30 min. *p. m.* he took its dista[nce] from *Venus*, by a reflecting telescope of Mr. *Hadley*'s, 14 [deg.] 40 min. but by a forestaff, 14 deg. 50 min. and a right [line] pass'd over the comet, *Venus*, and the *Pleiades*.

The night following about 6 hours 20 min. its distance f[rom] *Venus* was, by Mr. *Hadley*'s instrument, 13 deg. 25 min.

The rest of his observations, by such instruments as he t[hen] had, being none of the best, and the comet growing very d[im,] are as follows.

	D.	H.	M. *p. m.*		Deg.
Feb.	7.	6	47	The comet distant from *Venus*	7
		7	3	—— from *Aldebaran*	59
				—— from *Algenib* (by a forestaff)	17
				A right line drawn from the comet over *Venus* pass'd over the bright star in the side of *Perseus*.	

	D.	H.	M.		Deg.
Feb.	11.	7	14	The comet distant from *Venus*	7
		7	20	A right line over the comet, *Venus*, and the head of *Cassiopeia*.	

D. H.	M.	
Feb. 17 7	20	The comet was in a right line, and to the northward of two stars; the distance of the stars the Dr. suppos'd might be 40 min. and the comet from the least of them 30 min: These stars, he thinks, were the south node of *Pisces*; brightest from *Venus* 10 deg. 20 min. from *Aldebaran* 50 deg. 30 min. as he found it set down; but it must be very false.
		No star within sight of the comet (by the telescope).
20 30	7	The comet distant from *Aldebaran* 34 0
		—— from *lucida cap. ariet.* 19 30
21 about 30	8	Wanted about a degree of *occulus ceti*; which was the last sight he had of it.

The eclipse could not be well observ'd at *Philadelphia*, by reason of clouds: The Dr. rectified his clock by one of *Heath*'s large ring-dials.

At 7 hours 18 min. there was a small dent in the sun's edge; whence the beginning was 1 or 2 minutes sooner.

Just before the end, *viz.* at 10 hours 11 or 12 min. he had a sight of the sun again; and there was then a dent in the sun's edge: So that the end must be at 10 hours 13 or 14 min. in the morning.

About the middle of the eclipse there was a large spot near the middle of the enlightned part, which was the north side of the sun.

A Comet *seen in* Jamaica *in* January, 1736-7; *by Dr.* Rose Fuller. Phil. Trans. N° 446. p. 122.

AT *Spanish* town *Jamaica* there was the appearance of a comet, which was first perceiv'd about the 26. of *Jan.* 1736-7; but it must, by its plainness then, have been visible for some time before.

It was first of all in the west, some degrees below and directly under *Venus*: Every night it appear'd nearer to that star, but inclin'd northerly: In about a fortnight it was parallel to it; and in a week after, it was no more to be seen.

A

A Comet *ſeen at* Madras, Feb. 1736-7 O. S; *by M.* Sartoriu
Phil. Tranſ. N° 446. p. 122.

FOR 7 days preceding the 9. of *Feb.* 1736-7. O. S. about in the evening there appear'd a dim comet, as it was take to be: It was ſeen in the weſt, under *Venus* to the S. W.

Thro' a teleſcope of 10 or 11 feet it looked like a dim pale planet; its tail tended upwards.

An Obſervation of the Comet *ſeen at* Lisbon; *by Mr.* G. Vanbrugh, *with a Remark by Mr.* Machin. Phil. Tran N° 446. p. 123.

JAN. 29. 1736-7 on board the *Burford* Man of War, lyin at *Lisbon* at 6 hours 49 min. *p. m.* was ſeen a comet with long bruſh tail; at which time its altitude was found to 5 deg. 15 min. its diſtance from *Venus* 18 deg. 5 min. and *Ve nus*'s altitude was obſerv'd 20 deg. 40 min. it bore due weſt.

Mr. *Machin* remarks, that according to Mr. *Bradley*'s obſe vations at *Oxford*, the place at the time mentioned ought to ha been in Long. ♓ 13° 21′ ½ Lat. 0° 29′ S. ſo that there ſeems have been ſome miſtake in making this obſervation.

A Deſcription of ſome Mammoth's Bones *dug up in* Siberia *together with Obſervations thereon; by Dr.* Breyniu Phil. Tranſ. N° 446. p. 124.

IN *Phil. Tranſ.* N° 403, 404 Sir *Hans Sloane* has given ac counts of elephants teeth and bones found under ground. 1728 Dr. *Breynius* was buſied about the ſame matter; eſpeci ally to prove, that the extraordinary large teeth and bones foun under ground, and dug up in ſeveral places of *Siberia*, by th name of *Mammoth*'s or *Mammut*'s teeth and bones were

1. True bones and teeth of ſome large animals once livin and

2. That thoſe animals were elephants, by the analogy of th teeth and bones with the known ones of elephants.

3. That they were brought and left there by the univerſa deluge.

In 1730 Dr. *Meſſerſchmidt* return'd to *Dantzick* from h travels thro' *Siberia*, and was pleas'd to communicate to D *Breynius* ſome curious draughts of a very large ſcull, *dens ex ſertus* and *molaris*, with the *os femoris*, belonging to the anima commonly called *Mammoth*, found in *Siberia*; whereby S *Han*

Sir Hans *Sloane*'s and Dr. *Breynius*'s aſſertion, *viz.* that the teeth and bones, called in *Ruſſia*, *Mammoth*'s bones, are the true teeth and bones of elephants, is not only put in a greater light, but demonſtrated beyond all doubt.

In 1722 Dr. *Meſſerſchmidt* found two very large teeth; and upon making an accurate and nice examination of them, one was found to be a *dens molaris*, or grinder, a foot broad, half a foot long, and three inches thick, weighing 8 *lb.* and 3 *oz.* pretty entire, and only broken in two pieces, and the extremities of the roots ſpoil'd. The ſubſtance is between that of a bone and a ſtone, only that on the upper part of the outſide, some parallel undulated lines appear, which ſtill retain the enamel of the tooth.

The other is a piece of a *dens exertus*, or tuſk, eight inches long and three inches thick, weighing one pound and ſix ounces; in ſome places not differing from ivory, but in others calcin'd like the common *unicornu foſſile*.

What *Ysbrand Ides* in his travels from *Moſco* to *China* mentions of the *Mammoth*'s teeth and bones deſerves to be taken notice of; as alſo the journal of *Laurence Lange*'s journey to *China*, to be found in the preſent ſtate of *Ruſſia*, and the remarks of Capt. *John Bernard Muller*; vide the preſent ſtate of *Ruſland*.

Thoſe above-mention'd, as far as the Dr. knows, are the chief authors that have treated of the *Mammoth*'s teeth and bones, as a very remarkable and particular curioſity of *Siberia*.

From the teſtimonies of the foreſaid authors, it appears,

1. That thoſe teeth and bones are found in *Siberia*, chiefly in the northern parts, near the rivers *Jenizea*, *Trugau*, *Mongamſea*, *Lena*, &c. towards the icy ſea, at the time the ice has broken the banks of thoſe rivers, ſo that part of the adjacent mountains fall down; and that they are found in ſuch quantity as is ſufficient for trade, and to make a monopoly for the *Czar*, vide *the preſent ſtate of* Ruſland.

2. That ſometimes ſkeletons of this kind are found very near complete.

3. That thoſe teeth and bones are not found always of the ſame ſize, but ſometimes very large, as *dentes molares*, or grinders, of 20 or 24 pound weight, vide Capt. *Muller in loc. citat.* and *dentes exerti*, two of which weigh'd 400 pound; vide *Ysbrand Ides loc. citat.* ſometimes of a middle ſize, as thoſe above-mention'd; and at other times ſtill ſmaller.

4. That of thoſe teeth, *viz. dentes exerti*, ſome are uſed ivory, to make combs, boxes, and ſuch other things. Ca *Muller* ſaith (vide *Ysbrand Ides* and Capt. *Muller in loc. cita* that in every reſpect it reſembles the common ivory, being on a little more brittle, and eaſily turning yellow by the weath or heat.

From theſe quoted remarks, joined to ocular inſpecti Dr. *Breynius* thinks he may advance three things.

1. That thoſe *Mammoth*'s teeth and bones are true natu teeth and bones, formerly belonging to very large animals; cauſe they have not only the external figure and proportion, alſo the internal ſtructure, analogous to the natural teeth bones of animals.

2. That thoſe large animals have been elephants; which pears by the figure, ſtructure and bigneſs of the teeth, ac rately agreeing with the grinders and tuſks of elephants.

To be convinced hereof, one needs only compare theſe te with the figures of thoſe, dug up ſome years ago in *Irela* and of thoſe which repreſent the very natural teeth of elephan and conſider the accurate remarks made by Mr. *Molineux* others of the *Royal Society* thereon.

Nor needs any body doubt, that they are true teeth of phants, from the uncommon ſize of the *Mammoth*'s teeth abo mention'd; becauſe *Vertomannus*, as the famous Mr. *Jo Ray* tells us, has ſeen in *Sumatra* a pair of elephants tuſks t weigh'd 336 pound: And *Terzagus*, in *Muſæo Septalia* makes mention of one two yards long and 160 pound weigh

3 That thoſe teeth and bones of elephants were brought t ther by no other means than that of a deluge, by waves winds, and left behind after the waters returned into their re voirs, and were buried in the earth, even near the tops of hi mountains. And becauſe we know nothing of any particu extraordinary deluge in thoſe countries, but of the unive deluge of *Noah*, which we find deſcribed by *Moſes*; the thinks it more than probable, that we ought to refer this ſtra phenomenon to the ſaid deluge. In ſuch manner, may not o the holy ſcripture ſerve to prove natural hiſtory; but the tr of the ſcripture, which ſaith that *Noah*'s flood was unive (a thing doubted by many) may be prov'd again by natu hiſtory.

Here it is to be noted, that ſuch teeth and bones are likew to be found in ſeveral other countries beſides *Siberia*, as *Pola Germany*, *Italy*, *England*, *Ireland*, &c. but leſs common t

in *Siberia*, and not ſo well preſerv'd, but more waſted and calcined, without doubt, by the greater warmth of thoſe climates.

Hither are alſo to be referr'd the large bones found under ground, or rather tuſks of elephants, known by the names of ebur, or *unicornu foſſile*, which are of the ſame origin with the *mammoth*'s teeth, but different, as they are better preſerv'd; and therefore for a great part, have ſtill the natural bony ſubſtance, and may ſerve the workmen as natural ivory, and in ſome meaſure the phyſicians and apothecaries as ebur, or *unicornu foſſile*.

The following draughts of the above mentioned antediluvian bones of the animal, commonly call'd the *mammoth* of *Siberia*, or the bones of the foſſile ſkeleton of an elephant, are done to the ancient *Roman* ſcale contracted.

Fig. 1. Plate X. exhibits a front view of the head; it weighs 130 pound, three ounces, five drachms, and one ſcruple apothecary weight, or 152 *Ruſſian* pounds.

Its length or greateſt height is 48 inches.

Its greateſt breadth near the ears, 29 inches, five lines.

Its thickneſs from the forehead to the nape of the neck 22 inches five lines.

a a, the *os frontis*

b b the *ſutura ſagittalis*, hardly diſcernable.

c The bony *ſeptum naſi*, or external proceſs of the *os ethmoides*, without its fellow.

d d The coronal ſuture appearing imperfect.

e e The *oſſa ſincipitis*.

ff The *ſutura ſquamoſa* of the temples.

g g The *ſutura lambdoides* of the occiput.

h The external *proceſſus zygomaticus* of the *os temporum*.

i The poſterior lateral, or zygomatic proceſs of the *os malæ*.

k The upper proceſs of the *os malæ*, join'd with the outer proceſs of the *os frontis*, and conſtituting a part of the orbit of the eye.

l The outer proceſs of the *os frontis*, forming the upper part of the orbit.

m The anterior proceſs of the *os malæ*, join'd with the *os maxillare*.

n n The anterior proceſs of the *os maxillare*, forming the ſockets of the foremoſt teeth

o o The lower lateral process of the *os maxillare*, constitu ting the sockets of the grinders.

p A grinder in its socket, one on each side

q A surprizing cavity of the nose, stretching above t palate, through which, by means of its *proboscis*, the wat upon drinking, is convey'd into the throat, in the manner p culiar to the elephant.

Fig. 2. exhibits a view of the right side of the head.

a The round process of the *os occipitis*, entering into t *pelvis Atlantis*.

b b The *os occipitis* of a monstrous size.

c c The lambdoidal suture.

d The *os petrosum* with the *meatus auditorius*.

e The outer zygomatic process of the *os temporis*.

f The *sutura squamosa* of the *os temporis*.

g The *os sincipitis*

h The outer process of the *os frontis*, forming the upp part of the orbit.

i The bottom of the orbit.

k The hole of the optic and pathetic nerves, pointed to a prick'd line.

l The upper process of the *os malæ*, join'd with the out process of the *os frontis*, constituting part of the orbit.

m The anterior process of the same *os malæ*, join'd wi the *os maxillare*.

n The posterior lateral or zygomatic process of the sa *os malæ*.

o Another zygomatic process of the same *os malæ*, peculi to this skeleton.

p A hole near the foregoing process. *Qu.* If to let a ner pass to the teeth ?

q q The anterior process of the *os maxillare*, constituting t sockets of the foreteeth.

r r The inferior lateral process of the *ox maxillare* suppo ing the socket of an upper grinder.

s s A grinder fast in its socket, one on each side ; which no small argument that this skeleton belongs to an elepha and not to the chimerical *Behemoth* of the *Rabbins*, or t *Behæmaeth*, supposed different from the elephant ; of whi *Buxtorff*, the learned *Bochart*, and others, have treated.

Fig. 3. Exhibits the back view of the same head.

a The great hole of the *os occipitis*, for the passage of t *medulla oblongata* to the spine.

b b Th

b b The *processus globosi* of the *os occipitis*, cover'd with cartilage, entering into the *pelvis Atlantis*.

c The *os sphenoides cuneiforme*, or *basilare*.

d A peculiar and very remarkable sinus of the *os occipitis*, deeper than an *Ostrich*'s egg, serving in all appearance for the insertion of the muscles of the neck.

e e The outer surface of the *os occipitis* entire.

f f The surface of the same *os occipitis* broken through, exhibiting deep winding cells running on every side.

g The *os petrosum* with the *meatus auditorius*

h *Quære* if this be the place behind the ears, wherein elephants are wont to be kill'd, and where this one was damag'd by the knife?

i The outer zygomatic process of the *os temporis*.

k The outer process of the *os frontis*, constituting the upper part of the orbit of the eye.

l The bottom of the orbit, and the hole that gives passage to the optic and pathetick nerves, mark'd by a small line.

m The upper process of the *os malæ*, join'd with the process of the *os frontis*, and making up a part of the orbit.

n The posterior lateral or zygomatic process of the *os malæ*

o Another zygomatic process of the same *os malæ*, peculiar to this skeleton.

p. The lower lateral process of the *os maxillare*, supporting the socket of an upper grinder.

q The transverse process of the *maxillary* bone, or the greater *os palati*, which is very short in the skeleton of an elephant, whose tongue is scarce longer than a man's hand; which leave no room to doubt but this must be the skeleton of an elephant.

r r The upper grinders, one on each side, to which their opposites answer in the lower jaw: And as the elephants grinders are commonly four in number, this circumstance is another proof of Sir *Hans Sloane*'s and the Doctor's opinion.

s. The passage from the nostrils into the proboscis and ending in the fauces, with the *os vomer* very visible; though ill drawn through the neglect of the painter.

t t The anterior process of the *os maxillare*, constituting the sockets of the foreteeth, which are represented in fig. 6.

Fig. 4. represents a grinder, which seems to be the left one of the lower jaw, seen on the outside: It weigh'd 8 lb. nine ounces

ounces, and two drachms apothecary weight, or 10 poun[ds]
Russian.

Its greatest length is 12 inches.

Its perpendicular height five inches.

Its thickness or breadth three inches.

It is made up of above 20 tranverse *lamellæ*, a finger thic[k] perpendicularly erect, lying close to one another, and i[ts] root compos'd of two apophyses.

a a The plane surface of the exerted part of the grind[er] scarce making half the length of the tooth, contrary to wh[at] is observ'd in the grinders of the upper jaw.

b b The ends of the transverse *lamellæ*, terminating [in] the surface of the exerted part, and in this grinder as ha[rd] as stone.

c c The anterior *lamellæ* not extending to the exerted par[t,] and probably, lying hid either in the socket of the *os maxi[l]lare*, or under the gums.

d The anterior apophysis or root of the tooth, not qui[te] entire.

e The posterior apophysis or root, broken as the for[e]going.

f A deep *sinus* between the two *apophyses*.

Fig. 5. represents the tusk (by some improperly call[ed] the horn) of the right side, having a twofold direction [by] being bent outwards and backwards, which is peculiar to t[he] male elephant; it being straiter in the female: It is t[he] *ebur fossile* of the shops; and weigh'd 137 lb. one ounc[e] two drachms and two scruples apothecary weight, or 1[...] pound *Russian.*

Its length, or the exterior circumference of its back p[art] was 136 inches, five lines.

The circumference of the root, where it got clear of t[he] socket, was the greatest, being 18 inches, five lines.

The subtended arch from one extremity to the other [...] inches.

The same subtended arch *a c*, but bigger, being 91 inch[es.]

a The root hollow within, the cavity extending beyond t[he] place mark'd *b*.

b The root rising above its socket, where thickest.

c The place where the subtended arch was greatest, bei[ng] 61 inches.

d The point of the tusk somewhat bent outwards a[nd] backwards; tho' this curvature could not be expres's'd by t[he]
pain[...]

painter in a visible manner in the lesser subtended arch of 55 inches.

The tusk answering to the foregoing on the left side, was entirely like that on the right, except the contrary direction of its curvature, and its less weight, on account of having lost its point: For, it weigh'd but 128 lb, eight ounces, two drachms apothecary weight, or 150 pound *Russian*.

Fig. 6. represents the right thigh bone, exhibited to view on its inner side, which turns towards the body: It weigh'd 21 lb. six ounces, five drachms, and two scruples apothecary weight, or 25 lb. *Russian*.

Its perpendicular length 38 inches five lines.

The greatest breadth of its upper head, or *apophysis*, 11 inches.

Its circumference at the middle of the bone about 13 inches.

a The head cover'd with a cartilage, placed on its neck, and inserted in the socket of the *os ischium*, and fastened by means of two ligaments.

b The cervix or neck of the bone

c The upper external or greater *trochanter*.

d The lower internal or lesser *trochanter*.

e The place in the middle of the bone, where the circumference measur'd 13 inches.

f The *Sinus* facilitating the free motion of the *patella*.

g The other process, or inward head, covered with a cartilage, together with its fellow.

h Two vertical *sinus's* in the *tibia*, answering to the external *trochanter*.

The bones of this skeleton, with the ribs, *vertebræ*, &c. thereto belonging, were found in the sandy side of a steep hill, on the eastern bank of the river *Indigirska*, which falls into the northern ocean, not far from the mouth of the rivulet *Wolockowoi rugzei*.

The river *Indigirska* to the east of the river *Jena*, where it runs in its own channel, has not been laid down by M. *Witzen* in his map of the north east part of *Asia*: But its course is described by *Ysbrand Ides* in the map of his travels: And some of these bones are found now and then not only in these parts, but likewise in the sand hills on the rivers *Chatanga*, *Thomas*, *Tobol*, *Irtisch*, *&c.* all at a good distance from the sea, tho' neither elephants nor chimerical behemoth's have ever been seen in those countries: Wherefore the best judges follow

follow the opinion of Dr. *Woodward*, the *Scheuchzers* an
others, in taking them for the bones of *antideluvian* animals.

On the bank of the same river, which bank is call'd *Szt*
oijabr, *Michael Wolocbowicz* saw a piece of skin putrified
appearing out of the side of a sand-hill, pretty large, ver
thick, and cover'd with long hair, pretty thick set, and of
brown colour, somewhat like goats hair; which skin he coul
not take for that of a goat, but of the behemoth, insomuc
as he could not appropriate it to any animal he knew.

A large glandular tumour in the pelvis; and the pernicio
effects of crude mercury, given internally; by Dr. Cantwel
Phil. Trans. N° 446. p. 139.

ONE *P——r M——n* having been very ill for two
three years before had lost the use of his left leg an
thigh, was subject to frequent head achs and pains in h
bones, but especially his legs: For which as he had bee
given to women, his physicians salivated him twice, sent hi
to several hot waters, and gave him all the remedies the
could think of, but to no purpose. For, his illness increasin
he had from time to time great difficulty of making wate
and going to stool. In this condition he came from *Spain*
Marseilles, and from thence was sent to the waters of *Ba*
leruc, of which he drank a great quantity: But as they di
not pass, his physician there order'd him strong purge
with clysters of a decoction of tobacco, and the like. H
then began to vomit his excrements; upon which the phy
sician to a regiment in *Spain*, order'd him half a pound
crude mercury by the mouth, which made him suffer t
most exquisite pains; and his belly swell'd, and became
stiff as a drum. Upon this Dr. *Montagne* was sent for, wh
soon discover'd the error of the preceding practice, by feeli
a solid body near the *rectum*, which obstructing the passag
hinder'd the clyster-pipe from entering far enough into t
gut. After his departure, the patient was again order
clysters, which were injected with a crooked pipe, and sever
purges; till at the end of eight days he died, having h
belly bigger, stiffer and harder than ever.

Upon opening the *abdomen*, with a *Bistouri*, (it w
fill'd with a whitish liquor of some consistence: T
epiploon was entirely dissolv'd, and floated in this liqu
like so much pus. Upon pouring out this water, t
Doctor examined the intestines: The *colon* was burst u

der the ſtomach; and in three other places at its lower part; and ſo was the *cœcum*: The *ileum* was all inflamed, and in one part gangrened. The lips of the ruptures were plaiſter'd with excrement, all beſet with a vaſt number of globules of quickſilver; and when the inteſtines were diſengaged and taken out, the quickſilver fell from them in large drops. The other *viſcera* were in their natural ſtate, except the liver, which was gangrened.

The Dr. being very ſollicitous about the tumour, look'd into the *pelvis*, where he found an excreſcence of a prodigious ſize, which fill'd all its left ſide: He took the knife and clear'd all round the tumour: whereby he found the urinary bladder cloſe pent up between the anterior part of the tumour and the *oſſa pubis*, which occaſion'd the ſtrangury the patient had been tormented with. The *rectum*, which lay upon the middle of the os *ſacrum*, was alſo vaſtly preſs'd on by the tumour, which ſeemed to take its riſe from the holes that are in the left ſide of that bone. The ſurgeon, (while the Dr. laid down the knife, in order to ſeparate the *oſſa pubis* with a hatchet) cut out the tumour: Then the Dr. examin'd the *os ſacrum*, which was ſo very ſoft that his fingers enter'd it every where on the left ſide. The tumour was of an ovoid figure, cover'd over with ſeveral membranes; it weigh'd 2 pound and ½; its longeſt axis was five inches and ſomewhat more than three quarters, *French* meaſure; its ſhorteſt 4 inches three quarters. At firſt ſight he took it for a *parenchyma*; but upon diſſection, he found it analogous to the liver in ſubſtance, colour and conſiſtence. Its artery, vein and nerve were very large, and diſtributed thorough its whole ſubſtance: Wherefore the Dr. takes it to have really been one of the conglobate glands of the *pelvis*, whoſe veſſels yielding to the blood impell'd thither, with greater force and in a larger quantity than uſual, on account of the violent exerciſes of dancing, jumping, &c. which the patient had very much practis'd, caus'd its increaſe to that enormous ſize. Upon opening it, the Dr. obſerv'd three very apparent diviſions in it: And where the *pſoas* lay over it, and one of the *pyramidales* beat upon it, it was oſſified.

The Dr. preſerv'd it in brandy, and found that the ſmall veſſels that were moſt fill'd with blood preſs'd it out into the interſtices of the neighbouring ones.

The weight the patient conſtantly complain'd of at his left hip; the difficulty he had in going to ſtool, and that of thruſting a ſyringe far enough into the *rectum* to give him a clyſter

with any ſucceſs; the tumour itſelf, which was eaſily felt up putting the finger into the *auus*; together with the palſy of t left leg and thigh, might, the Dr. thinks, have given other i dications to the phyſicians, than thoſe they took. And the D thinks that the frictions and other heating medicines the pati was plied with, contributed to augment his illneſs.

In fine, the crude mercury the patient ſwallow'd, the v quantity of *Balleruc* water he drank before it, with the ſtro cathartics taken by the mouth and *anus*, ſeem to have cut h ſhort of ſome months, which he might have liv'd, had he u no other remedies than a ſlender relaxing diet.

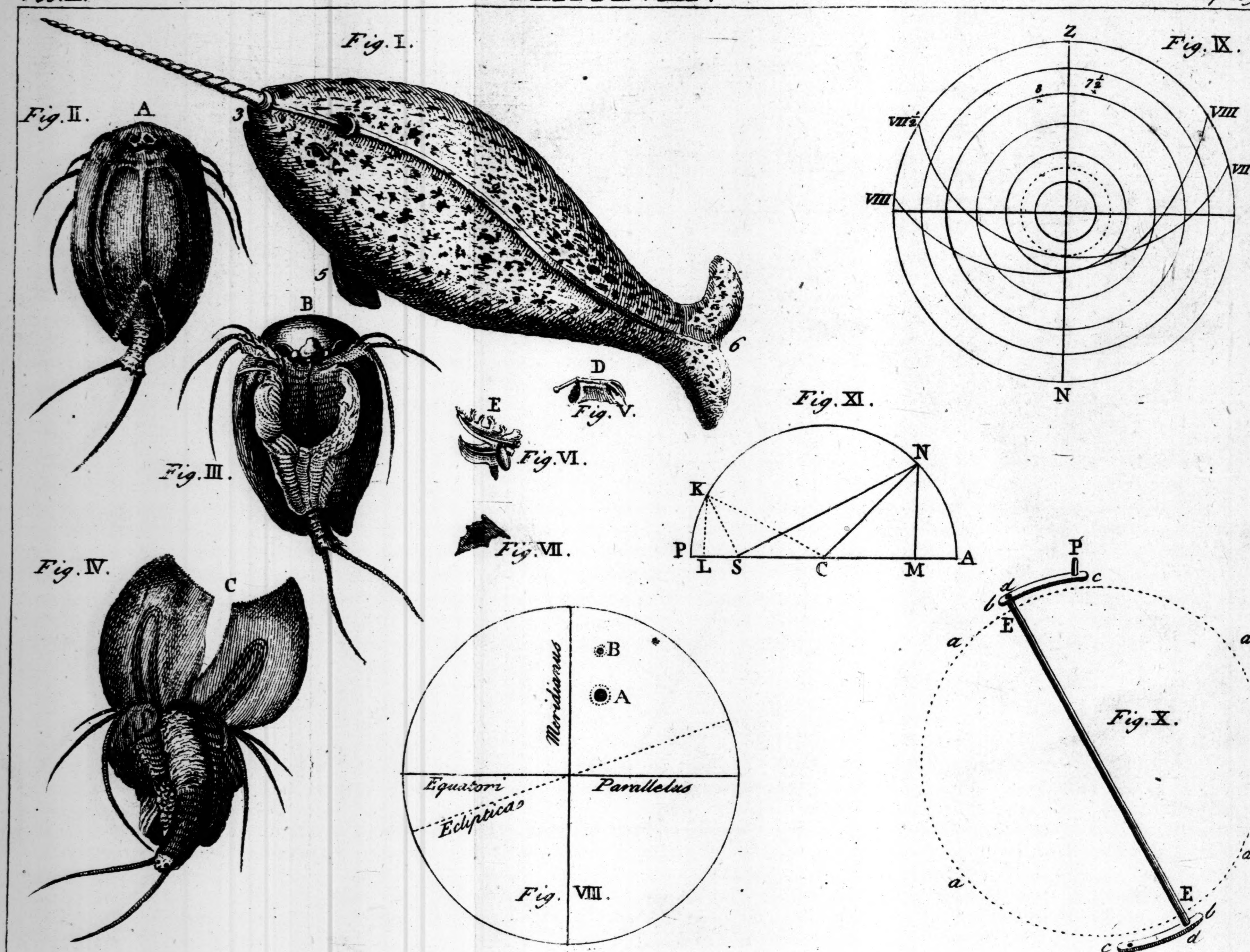
A Narhual *or Unicorn* Fiſh, *taken in the River* Oſt, *in t* Dutchy *of* Bremen; *by Dr.* Steigertahl. Phil. Tra N° 447. p. 147.

TOwards the latter end of *January*, 1736, N. S. th was taken a ſort of whale, call'd the *narhual* or *ſea-u corn*, in the river *Oſt*, where it falls into the *Elbe*, near the v lage *Bellum* in the Dutchy of *Bremen*, four miles from the There was a great quantity of fat taken out of it, to ma *thrann* or whale-oil; but it was obſerv'd that this train-oil h an almoſt intolerable ſtench, by reaſon that this *narhual* fe on carcaſſes: For, *nar* ſignifies a carcaſs or dead body, acco ing to *Valentini* in his *Muſæum Muſæorum* B. III. ch. 30.

There was ſuch care taken of the ſkin, before the diſſecti that it was cur'd with ſalt and alum; and ſtuffed in ſuch m ner as to exhibit the juſt figure of the fiſh; having left wit the bones of the ſcull, and ſome *vertebræ* near the tail.

The ſkin was ſpotted with dark brown ſpots upon a wh ground: The *epidermis* was tranſparent; and under it was a ther ſkin very thin and ſpotted; but the true ſkin was bro and near an inch in thickneſs. On the top of the head was o found a ſemilunar hole, as in the porpoiſe, according to the ſcription given by *John Daniel Major*, and publiſh'd in *Miſcellan. Academ. Nat. Curioſ. Dec.* 1. *An.* 3. p. 22 & ſ This hole opens into the two canals running thorough the to the palate, and are called by *Major*, *ductus hydrag* There was no opening or outlet for the *fæces* obſerv'd in ſkin; and Dr. *Steigertahl* was told, that this *narhual* voi them thorough this hole on the top of the head.

As to the horn, the Dr. agrees in opinion with *Wormius* others, who take it for a tooth: But he cannot believe that ſole uſe is to break the ice; it rather ſerving the fiſh for ſeek its food.



G. Smith del. Hulett Sculp.

A Captain of a *Greenland* veſſel aſſur'd the Dr. that being upon the coaſt a whale-fiſhing, and having taken one; as he was turning the whale to get at the fat, he found on the oppoſite ſide to him, a *narhual*, that had ſtuck his tooth into the whale's belly, up to its mouth, and ſuck'd the blood and humours.

The Dr. only ſaw the ſtuffed ſkin, as it was carrying to *Leipſic* fair: And as he finds that the figure engrav'd and printed at *Hamburg* has a good reſemblance to what he ſaw, he has annex'd a print of it, as repreſented Fig. 1. Plate XI.

1. Shews a ſemilunar hole, thro' which the fiſh upon dying, caſt out water and blood.

2. A ſmall riſing on the middle of the back, and fleſhy as the fins.

3. The mouth very ſmall, without teeth in the upper jaw, except this *dens prominens*, or tuſk, which by ſome has been taken for a horn: There was no lower jaw found.

4. The eye very ſmall.

5. The fin on the right ſide, which, as well as the oppoſite one, is fleſhy.

6. The tail fleſhy like the fins; which taken, according to its width, is not vertical but horizontal.

7. The prominent tooth or tuſk, commonly taken for a horn.

The length of this *narhual* from N° 3 to 6 was 17 feet 9 inches.

The tooth 6 feet 3 inches.

The greateſt thickneſs, meaſur'd round, was 14 feet.

The ſkin was ſmooth without ſcales, like that of an eel, and was white markt with blackiſh ſpots.

A Deſcription of the ſame Narhual; *by Dr.* Henry Hampe. Phil. Tranſ. N° 447. p. 149.

IN a creek, called the *Belubmer wadt*, belonging to the *Bailiwick* of *Newhaus* in the Dutchy of *Bremen*, was caught alive an unknown fiſh of a large ſize, 18 or 20 feet in length, and 4 in diameter. On the fore-part of the head, juſt above the mouth (which is very ſmall) it has a horn 6 feet long, white like ivory, and curiouſly twiſted. The body is white, ſprinkled with black ſpots, and ſmooth like an eel. The head in proportion to the body, is very ſmall, about 16 inches in length, and the ſame in diameter. The eyes are alſo ſmall, about the bigneſs of a ſixpence. On the upper part of the head is a hole about 3 inches in diameter, out of which he probably

ſpouts out water like the whales. On each ſide of the neck are placed two black fins, one above the other, and at a ſmall diſtance from each other. They are half an inch in thickneſs, of a hand's breadth and two feet in length, round on the forepart, all fleſhy, and of a liver-colour.

A Water Inſect, *not hitherto deſcribed*; *by M.* Klein. Phil. Tranſ. N° 447. p. 150. *Tranſlated from the* Latin.

A Friend of M. *Klein*'s preſented him with a water inſect, found at *Uderwanga* in *East Pruſſia* among freſh water crabs, and utterly unknown to the crab fiſhers.

From the great number of its feet, and ſurpriſing facility of moving them, it may with equal, if not better reaſon be call'd *ſcolopendra aquatica ſcutata*, than *Aldrovandus* p. 721. *de cetis* calls a certain fiſh of the whale kind, *ſcolopendra cetacea*.

A (Fig. 2. Plate XI.) repreſents the inſect on its upper part, cover'd with a ſhield; which nearly reſembles tortoiſe-ſhells, only that along the middle of the back it is a little gibbous, and towards the extremity of the body has a triangular *hiatus*, ſlightly indented; it is entire, and almoſt of the ſame ſubſtance (yet of a more dilute colour) with the ſheaths of the wings of the *ſcarabæi Gœdarti*, produced from weevils or what is called *ſcarabæus roſarum*. The eyes paſs out thro' the ſhield, and are a little prominent.

B (Fig. 3.) repreſents the inſect delineated on the under part; where at the ſame time appears a vaſt number of legs: Each of theſe has a certain bag as at D (Fig. 5.) terminating in three feet, or rather toes: The two anterior ones have this in peculiar that their three feet or toes are longer than the others, tho' they differ from one another in length. All the toes of the greater and leſſer feet conſiſt of ſimilar articulations; and ſuch as the hairs of the forked tail of this *ſcolopendra*, or the *antennæ* of other inſects have.

M. *Klein* thinks he ſhall not be much miſtaken if he ſuppoſe, this inſect makes uſe of the longer toes of both the anterior feet before, and of the hairs of its forked tail behind for *antennæ*, by means of which it timeouſly diſcovers either its purſuing enemies, or ſuch as it meets with in lurking places; unleſs one would chuſe to take the two ſhort horns, that appear in the Fig. at that place, where we are reaſonably to look for the head, for *antennæ*.

C (Fig. 4.) repreſents the body bared of its ſhield, view'd on the back; on account of which the ſhield is carefully divided

vided lengthwiſe, which as to the part explain'd is not continu'd with the back. In the thin cuticle of the lower part of the ſhield, and that on both ſides may be obſerv'd (as in the Fig.) punctures like needle work.

M. *Klein* could not certainly determine, whether it ſucks in the water thro' theſe apertures into the cavity between the gibbous ſhield and the cuticle, and again emits it; or whether it fills the cuticle with air, or empties it according as it has a mind either to go down to the bottom or riſe up to the top of the water. The inſections are about 30, but the legs cannot eaſily be numbered. In the extreme part of the body which ſeparates the ſhield, the rings of the inſections are beſet with ſmall ſpines, and that in the ſame order, as they appear delineated Fig. 2 and 4.

D (Fig. 5.) repreſents one of the legs next the anterior ones, together with the little bag.

B (Fig. 3.) repreſents another leg in a different view.

As long as this inſect liv'd, it continually and with ſingular facility mov'd its feet, drawing at the ſame time into its ſheath and putting out again, the extreme part of its body.

M. *Klein* could find no trace of this inſect amongſt authors.

The ſame Sort of Inſect *found in* Kent; *by Mr.* Littleton Brown; *with a Remark*; *by Dr.* Mortimer. Phil. Tranſ. N° 447. p. 153.

MR. *Brown* preſented to the *Royal Society* to be kept in their *Muſæum*, a creature, whoſe name he could not learn from any books or perſons he had hitherto met with: He brought it from a pond upon *Bexby Common* in *Kent*, where great numbers had been obſerv'd for five weeks before. The pond was quite dry the 24th of *June*, 1736; but upon its being fill'd with a great thunder-ſhower on the 25th, within two days the pond was obſerv'd to ſwarm with them: And what Mr. *Brown* thought obſervable was, that there is no duct or channel that could convey them from any adjacent place.

E (Fig. 6. Plate XI.) repreſents this inſect; its legs are very extraordinary. Dr. *Mortimer* counted 42 on a ſide in one of thoſe found in *Kent*; the 20 next the head are nearly of a ſize, but then they grow gradually ſmaller and ſmaller towards the tail. He took out one of the larger ones of the left ſide of the cheſt; the foot conſiſts of five flat membranous claws, with a ſtiff rib along their middle, and beſet with hairs on the edges, like thoſe of crabs. On the lower ſide of the bag hangs an oval

oval bag, and beyond that grows a large thin membrane which may be extended by a bony rib that runs cross it: this membrane and the whole foot is convex on the side next the head, and concave on that next the tail; the thigh, or first joint of the leg, is webb'd on each side: So that the whole structure of the legs seems to shew that they are rather design'd for swimming than walking.

The leg represented at E (Fig. 6.) drawn when the insect lay on its back as at B. (Fig. 3.) Several parts of this insect, tho' no bigger than the figures, have some resemblance to those of the *Molucca* crab.

An Abstract of Meteorological Diaries for the Years 1729 *and* 1730; *by Mr.* Hadley, Phil. Trans. N° 447. p. 154.

BEFORE Mr. *Hadley* proceeds to the tables, he gives some account of each of the diaries of the years 1729 and 1730, and their contents.

The diary kept by Mr. *Hauksbee*, by order of the *Royal Society*, at their house in *Crane Court*, consists of observations of the barometrical heights twice a day, *i. e.* morning and evening, in inches, decimals, and centesimals; as also of the thermometer, in its proper graduations, and the weather, with the hour of each observation: The winds are omitted. The depth of the rain is set down several times for the most part in each month, the sum of which is to be divided by 10; the funnel which catches the rain being so much bigger in surface than that of the vessel which receives the rain from it.

That from *Southwick* near *Oundle* in *Northamptonshire*, by Mr. *Lynn*, contains the height of the barometer once a day, and the winds, the steadiness and strength of which is likewise mark'd in proper characters: Observations made of the upper and under currents of the air, when it so happened. The thermometer is mark'd twice a day, the weather often, both by day and night; the rain from time to time; and the quantity of each particular shower often set down by itself, with some other miscellaneous observations, as halo's, thunder-storms, and sudden changes of wind, *&c.* He takes notice of his thermometer being placed in an out-house exposed to the air, but screen'd from the sun, which is a proper precaution in using that instrument. The remarkable rises and falls of the mercury are also mark'd with proper characters, which method would likewise be

usef-

ſeful in the other columns, for compariſon of diaries, if ſome certain rule were agreed on.

That from *Kent*, 16 miles ſouth eaſt from *London*, gives an account of the barometer once a day; ſometimes twice or thrice, with the hour of each obſervation, and the winds, weather, and rain; the proportion of which for every day is given at the end of each month. There is alſo a ſeparate column for the height of the clouds, which the obſerver divides into three orders; and where there are two orders at a time, they are both noted; as alſo when any of them move with different velocities or directions, which he ſuppoſes to be commonly a ſign of change of the wind: But he does not inform us how he determin'd their heights or velocities. The reigning wind, and general ſtrength of it, is noted at the end of each month; likewiſe the eclipſes, and the times of the new moons, which he obſerves make it appear, that the notion of the change of weather depending on the age of the motion is without any ground; with other miſcellaneous obſervations, as the *aurora borealis*, fruitfulneſs or ſterility of the ſeaſon. He had no thermometer.

That from *Hudickſwall* in *Sweden* by M. *Olave Broman* ſhews the height of the barometer ſometimes once, ſometime twice or thrice a day O S. in *Engliſh* meaſure, with the winds, and their ſtrength, and the weather. There is alſo annex'd to the diary of 1729 an account of the height of the ſea water for every day, which Mr. *Hadley* obſerves to vary in the whole about two inches, and is ſometimes interrupted by rain-floods. This, probably, relates to the tides in the gulph of *Bothnia*. Mr. *Hadley* has not inſerted theſe in the tables, as not being of general uſe. There is no thermometer, nor the quantity of rain ſet down.

That from *Riſinge* in *Oſtrogothia*, in *Sweden*, by *Sueno Laurelius*, paſtor and provoſt gives the height of the barometer for the moſt part three times, ſometimes five times a day, together with the hour of the obſervations O. S. in *Engliſh* meaſure. He refers to the diary of 1727 for the deſcriptions of his barometer and thermometer. The winds together with the degree of their ſtrength, the weather and the depth of rain, are likewiſe ſet down.

In that from *Upſal* in *Sweden*, by M. *Andrew Celſius*, profeſſor of aſtronomy, obſervations are made three times a day of the barometer and thermometer; both which inſtruments were made by Mr. *Haukſbee*; as alſo the winds, with their

their ſtrength, and the weather, and depth of rain from time to time are ſet down.

That from *Svenaker* in *Sweden* near *Trolhetta*, by M. *Torſtanus Waſſenius* contains the height of the barometer twice a day, ſometimes three times O. S. in *Swediſh* feet inches and decimals, which being ſuppoſed to be to *Engliſh* as 974,375 to 1000, the mean heights are reduced in the following tables to that meaſure. The winds alſo with their ſtrength, and the weather, are noted. There is no thermometer. Notice is taken of thunder ſtorms, and other meteors.

N. B. In the account of the *Swediſh* diaries for 1728, *Svenaker* is ſaid to be 109 *London* feet above the ſurface of the ſea. The mean height of the barometer there in theſe two years, is but 29,47 inches, which would give the height of the place near 450 feet, according to the reckoning hereafter mentioned: Therefore Mr. *Hadley* thinks there muſt be ſome miſtake; perhaps ſome air might have gone into the top of the tube, or the ſcale be placed too high.

That from *Lunden* in *Sweden*, by *Conrad Quenſel* profeſſor of mathematicks in the *Caroline* academy, contains obſervations of the barometer twice a day, O. S in *Engliſh* inches and decimals and fourth parts of them; the winds with their ſtrength, and the weather. The thermometer is *Florentine*, therefore the obſervations are not inſerted in the table. The monthly mean there given, is taken ſimply between the two extremes. Mr. *Hadley* has given it in the tables taken the other way, as all the reſt are.

That from *Bygdea* in *Sweden*, by M. *John Telius*, paſtor there, contains obſervations of the barometer twice a day, morning and evening O. S. in *Engliſh* inches and decimals; the winds, with their ſtrength, and the weather. The two laſt months are wanting. There is no thermometer.

That from *Betna* in *Sudermanland*, by M. *And. Geringius*, paſtor and provoſt, contains obſervations of the barometer thrice a day, except in the firſt part of *January*, O. S. in *Engliſh* inches and decimals, the winds with their ſtrength, and the weather, with other meteorological obſervations; as alſo on the ſeaſons, as to fruitfulneſs and ſterility, *&c.* The *aurora borealis* is frequently mentioned. The thermometer is peculiarly graduated, and ſo could not be inſerted. There is a column for rain, with marks, which Mr. *Hadley* underſtood not.

From

From *Wittemberg* in *Saxony*, there are two diaries communicated; the one from M. *Mat. Hasius*, professor of mathematics; the other from M. *Weidler*: That by M. *Hasius* has the height of the barometer several times a day, sometimes four or five times O. S. in *English* inches and decimals, and the parts of these in vulgar fractions, but reduced to decimals in the tables. He employ'd two barometers and thermometers: Those marked I. are Mr. *Hauksbee*'s; those markt II. *Florentine*. The coldest day he ever observ'd was *Feb.* the 5th 1726. It also contains the winds, with their strength, and the weather. M. *Weidler* gives the height of the barometer three times a day, N. S. in *Paris* inches and lines, and the parts of these in vulgar fractions; likewise the winds, and their strength, and the weather, and the quantity of rain in cubes and lines: but at the end of each quarter the depth is given in *Paris* inches and lines. The thermometer is Mr. *Hauksbee*'s, There are some astronomical observations of eclipses, *&c.* He takes notice, that an occultation of *Venus* by the moon, observ'd with an 18 foot telescope, may serve to prove the moon to have an atmosphere: For, being then in its quadrature with the sun, it appeared to lose its cusps, and become oval, when it came near the moon. Mr. *Hadley* for two years made use of M. *Hasius*'s barometrical and thermometrical observations, being O. S. and *English* measure, tho' the three last months of 1730 are wanting. The depth of rain is taken from M. *Weidler*, and reduced from *Paris* to *English* measure, supposed to be as 1068 to 1000; but is not reduced to the *old style*. M. *Weidler* refers to his meteorological observations sent the *Royal Society*. The year 1730 he observes to have been more wet and cold than had been known, and the sky very misty.

That from *Padua* by S. *Poleni* shews the height of the barometer once a day O. S. in *English* inches and decimals, the winds, and sometimes their strength, and likewise the weather.

A particular account of his thermometer, as also the observations on his diaries, containing in all six years, have been published in *Phil. Trans.* N° 421. The depth of rain is given both for the *old* and *new style*.

That from *Bengal*, by Mr. *Bellamy*, preacher to the factory, contains the height of the thermometer twice a day, morning and evening, as also the winds with their strength, and the weather for the year 1730. The medium of the ther-

thermometer is taken both from the evening and morning heights; the difference there being very considerable in proportion between morning and evening.

That from *Boston* in *New-England*, by Mr. *Dudley*, shews the weather three times a day, and the wind once or twice. There is no barometer or thermometer.

In 1730 those from *Crane-Court*, *Southwick*, *Kent*, *Hudicksvall*, *Ostrogothia*, *Upsal*, *Svenaker*, *Lunden*, *Bettna*, *Wittemberg*, *Padua*, and *Boston*, are continued in the same manner. The *Abo* observations for the year 1730, by Mr. *Sporing*, shew the height of the barometer twice a day in *Swedish* inches and decimals; but the mean heights are reduced to *English* measure in the tables: They likewise shew the winds and weather, and in the last column the *auroræ boreales*, which are frequent in most months of the year.

That from *Naples*, by S. *Cyrillus*, shews the height of the thermometer (which is one of Mr. *Hauksbee*'s) once a day, as also the winds with their strength, the weather and the depth of rain in *Neapolitan* measures, 23 of which make a *London* inch, to which they are reduced in the tables. The barometrical heights he has not set down; because he found them not to agree with those of former years, which made him suspect his instrument to be out of order: But as it appears he had remov'd his habitation, it might be owing to its being situated higher or lower than the former. An eruption of *Vesuvius* happening, an account is given thereof, and of damage done by lightning, and likewise of the seasons, as to fruitfulness and healthiness, vide *Phil. Trans.* N° 424.

Note, in some of the diaries, the numbers shewing the decimal parts of the inches, are set down in single figures, without any rule or cypher to distinguish them from the centesimals, and in others the centesimals in like manner: But it is easy to form a judgment of the authors method by considering them.

Having given an account of the method and contents of the several diaries, Mr. *Hadley* proceeds to the tables extracted from them.

The barometrical table consists of two parts; the upper shews the mean height of the barometer, taken in the method formerly proposed by Dr. *Jurin*, for every month throughout the year, for each place, and in each column the highest month is mark'd with an *h*, the lowest with an *l*, to make them more observable to the eye. At the bottom the mean of the whole year is set down for each place. At the

the foot of this table is another, shewing the greatest ascent and descent of the mercury in that year, with the particular day of each, the difference of which is the range; a circumstance Dr. *Derham*, and other observers, have usually taken notice of.

Next follows the table of the monthly thermometrical heights, extracted in Dr. *Jurin*'s method also in every place where the *Society*'s instruments were used; and at the bottom the mean of the whole year; and likewise the hottest and coldest day in each place.

In the last place are the tables of the depth of rain, where it is contain'd in the diaries.

Mr. *Hadley* chose to put each of these matters in separate tables, that the eye might be able to take a view of the whole, and compare the state of each place with the others, as to every particular, with less confusion; as also because several of the diaries have nothing upon one or more of these heads.

Note, The mean heights both of the barometer and thermometer are extracted only from the morning observations, some of the diaries containing no more; except in the mean heights of the thermometer at *Bengal*, which are taken both from the morning and evening observations.

A Table *of the monthly mean* Barometrical *Heights, and also of the greatest Ascents and Descents of the* Mercury *observ'd in several Places, in the Year* 1729, *Inches and Decimals.*

A.

1729	*Crane-Court, London.* Lat. 51° 31	*Southwick* in *Northamptonsh.* Lat. 52° 54	In *Kent.* Lat. 51°	*Hudiksval* in *Sweden* Lat. 62°	*Ostrogothia* in *Sweden* Lat. 56°	*Upsal* in *Sweden.* Lat. 59 48
January	30 08	29 70	29 41 h	29 49	29 20 l	29 43 l
February	02	66	37	30 02	576	92
March	29 93	54	37	29 63	27	55
April	93	60	26	30 04 h	62 h	30 16 h
May	95	57	29	29 82	38	29 71
June	30 07	69	36	86	35	74
July	29 97	64	28	69	20 l	60
August	30 9 h	72 h	38	78	35	65
September	29 69	42	09	90	42	81
October	83	52	09	55	32	54
November	61 l	32 l	28 94 l	45 l	25	54
December	83	52	29 25	75	52	79
Mean of the whole Year.	29 91	29 575	29 ,257	29 ,748	29 371	29 73

C

*Mer.*High.	30 55 *Feb.* 26	30 ,11 *Feb.* 26	30 36 *Feb* 23	30 70 *Feb.* 28	30 50 *Jan.* 7	30 30 *Dec.* 20
Lowest	28 31 *Jan.* 18	28 23 *Jan.* 18	28 18 *Oct.* 12	28 75 *Oct.* 12	28 95 *Nov.* 27	28 90 *Nov.* 10
Differ.	2 [illegible]	2 [illegible]	2 [illegible]	[illegible]	[illegible]	[illegible]

The foregoing Barometrical Table *continued.*

The foregoing Barometrical Table *continued.*

B.

1729	*Svenaker* in *Sweden.* Lat. 50° 10	*Lunden* in *Sweden* Lat. 55. 42	*Bygdea* in *Sweden* Lat. 63. 40	*Betna* in *Sweden.*	*Wittemberg* in *Saxony*, by Mr. *Hasius.* Lat. 52.	*Padua* in *Italy* Lat. 45 15
January	29 44	29 42	29 18	29 77	29 83 h	29 74
February	62	54	76	30 18 h	778	725
March	28	28 38	41	29 84	65	66
April	65 h	57	82 h	30 17	64	85
May	44	48	61	29 89	35	67
June	56	59 h	63	88	77	74
July	43	44	50	72 l	34 l	63 l
August	52	57	57	84	79	79
September	51	44	76	92	65	65
October	37	46	33 l	76	67	75
November	18 l	33 l		75	51	64
December	53	52		99	74	89 h
Mean of the whole Year	29 46	29 47	29 ,557	29 892	29 643	29 727
Mer. High Lowest Diff.	30 41 *Feb.* 28 28 31 *Jan.* 18 2 10	30 ,40 *Feb.* 27. 28 23 *Jan.* 18. 2 17	30 36 *Feb.* 23. 28 18 *Oct.* 12. 2 18	30 70 *Feb.* 18. 28 75 *Oct.* 12. 1 95	30 50 *Jan.* 7. 28 95 *Nov.* 27. 1 55	30 30 *Dec.* 20. 28 90 *Nov.* 10. 1 40

D.

A Table *of the monthly mean* Thermometrical *Heights in several Places in the Year* 1729.

1729.	*Crane-court.*	*Southwick.*	*Upsal.*	*Wittemberg.*
January	67 ,3	70	80	70 ,9
February	69 ,2	74	82 ,7	67 ,5
March	60 8	69	70 ,6	56 ,3
April	55 ,2	61	58, ,9	51 ,6
May	42 ,6	53	48 ,5	36 ,0
June	34 ,9	43	37 ,3	30 ,2
July	33 ,1	42	35 ,1	29 ,0
August	33 ,8	43	40 ,4	29 ,65
September	38 ,6	46	47 ,1	37, 6
October	51 ,1	57	60 ,8	50 ,2
November	56 ,8	60	66 ,3	59 ,6
December	58 ,8	63	71 ,4	70 ,6
Mean of the Year.	50 ,1	56 ,7	57, 6	49 ,09
Thermom. Highest	12 ,5 *June* 10.	13 *June.* 10.	22 5. *June* 9.	14,75. *May* 23.
Lowest	80 ,5 *Jan.* 7.	88 *Jan.* 4.	97 *Jan.* 5.	95 ,0. *Jan.* 1.

A Table *of the Depth of* Rain *which fell in several Places in the Year* 1729. *in Inches and Decimals.*

1729.	*Crane-Court.*	*South-wick.*	*Kent.*	*Ostrogo-thia.*	*Upsal.*	*Wittemberg Stylo Novo.*	*Padua.*
January	,739	,16	,499	,830	1 ,153		1 ,085
February	,785	,48	1 ,069	1 ,050	1 ,027		1 ,245
March	1 ,125	1 ,31	1 ,286	,600	,826	,48	2 ,902
April	1 ,600	1 ,10	2 ,197	,005	,000	,905	2 ,768
May	1 ,515	1 ,55	2 ,216	3 ,865	,875	,94	2 ,634
June	1 ,200	0, 83	,730	2 ,930	2 ,450	,815	3 ,134
July	1 ,04	2 ,26	2 ,153	1 ,615	2 ,578	1 ,31	4 ,526
August	3 ,04	2 ,44	2 ,533	1 ,405	,747	1 ,365	,578
September	3 ,505	5 ,32	2 ,343	2 ,940	2 ,687	,78	3 ,267
October	1 ,420	2 ,20	2 ,218	1 ,050	,139	1 ,43	6 ,294
November	2 ,425	4 ,18	4 ,334	2 ,150	,855	1 ,305	4 ,186
December	1 ,950	1 ,68	1 ,947	3 ,040	1 ,140	1 ,295	2 ,804
Total.	20 ,344	23 ,51	23 ,525	21 ,480	14 ,477	11 ,625	35 ,423

A Table *of the monthly mean* Barometrical *Heights, and also of the greatest Ascents and Descents of the* Mercury *observed in several Places, in the Year* 1730, *in Inches and Decimals.*

1729.	*Crane-Court, London.* Lat. 51° 31	*Southwick* in *Northamptonsh.* Lat. 52° 54	In *Kent.* Lat. 51°	*Hudicksvall* in *Sweden.* Lat 62°	*Ostrogothia* in *Sweden.* Lat. 56°	*Upsal* in *Sweden.* Lat. 59° 48
January	30 ,04	29 ,79	29 51 h	29 61	29 50	29 66
February	29 ,61	39	06	50 l	29	60
March	,52 l	34 l	03 l	77	45	79
April	,90	66	37	77	52	77
May	,76	55	15	68	58	72
June	,83	60	24	75	35	75
July	,84	61	31	82	31	78
August	,94	70	39	75	38	74
September	,90	34 l	37	75	44	75
October	68	49		96 h	64	93 h
November	79	55		50 l	26 l	56 l
December	30 ,09 h	83 h		84	68 h	89
Mean of the whole Year	29 ,825	29 ,57	29 ,27	29 ,725	29 ,455	29 ,745
Mer. High.	30,35 *Dec.* 1.13.	30,30 *Jan.* 10.	30,01 *Jan.* 10.	30,52 *Dec.* 1.	30,40 *Dec.* 1.	30,71 *Dec.* 1.
Lowest	28,70 *Mar.* 8.	28,53 *Mar.* 8.	28,28 *Mar.* 8.	28,70 *Dec.* 10.	28,45 *Jan.* 18.	28,90 *Dec.* 10.

A.

The foregoing Barometrical Table continued.

B.

1730.	Svenaker in Sweden. Lat. 58° 10	Lunden in Sweden. Lat. 55 42	Betna in Sweden. Lat. 58 49	Abo in Finland. Lat. 60 40	Wittemburg in Saxony, by Mr. Hasius. Lat. 52	Padua in Italy. Lat. 45° 15′
January	29 39 l	29 57	29 96	29 68	29 823 h	29 88
February	46	23 l	81	435	428 l	55
March	42	34	97	61	48	46 l
April	59 h	56	30 03	705	677	69
May	54	46	29 89	55	99	67
June	53	55	89	60	667	67
July	40	51	87	665	671	69
August	53	59	89	56	776	80
September	48	57	30 04	30 05 h	80	82
October	56	61	11	29 76		72
November	46	30	29 74 l	355 l		76
December	43	65 h	30 12 h	68		96 h
Mean of the whole Year.	29 ,48	29 ,495	29 ,943	29 ,637	29 ,701	29 ,705
Mer. High.	30,42 *Dec.* 1.	30,22 *Dec.* 1. 13.	30,98 *Dec.* 1.	31,20 *Dec.* 1.	30,37 *Jan.* 30.	30,40 *Dec.* 20.
Lowest	28,43 *Dec.* 10.	28,61 *Dec.* 31.	28,96 *Dec.* 10.	28,64 *Nov.* 23.	29,00 *Feb.* 27.	28,98 *Feb.* 27.
Differ.	1 99	1,61	2,02	1,56	1 37	1 42

D.

A Table *of the monthly mean* Thermometrical *Heights in several Places in the Year* 1730.

1730	*Crane-Court.*		*Southwick*		*Upsal*		*Wittemberg.*		*Naples*		*Bengal*	
January	67	9	69		74		72		50	5	30	
February	63		68		72		67		41	3	22	,4
March	56	,27	62		74	5	60		40		6	,9
April	50	2	58		56	2	48		40		4	,0
May	41	30	49		42	4	35		40		5	,2
June	37	7	46		29	9	29		19	5	5	,3
July	35	22	42		21	90	26		16	7	8	,8
August	33	8	44		34	05	29		14	2	9	,4
September	39	8	47		50	21	40		22	6	6	,2
October	50	1	55		62	20			29		14	,4
November	55	5	59		72	27			40	1	23	,4
December	49	51	70		73	10			49	9	32	,3
Mean	48	35	55		55	22			34	3	14	,02
Highest	10. 5.	*July* 25	16	*July* 24.	9 1	*July* 27.	11	*July* 25.	9	*Aug.* 17.	0	*Jan.*
Lowest	77. 5.	*Jan.* 7	83	*Dec.* 14.	86 7	*Mar.* 16.	81 50	*Jan.* 15.	60	*Jan.* 10.	40	*Dec.*

A Table

A Table of the Depth of Rain which fell in several Places in the Year 1730. In Inches and Decimals

1730	Crane-Court		South-wick		Kent		Ostrogo-thia		Upsal		Wittemberg, Stylo Novo.		Naples		Padua	
January		450		45		624		795		164		78	3	89		112
February	1	230	1	53	2	054		870		412	1	68	1	434	2	906
March	3	595	2	61	4	067	2	730	1	983	2	86		739	4	592
April		,670		84		985		605		165	1	98	2	39	1	638
May	1	755	2	5	1	805	2	260	4	120	3	23	1	39	4	467
une	3	755	3	39	2	876	1	531		755	2	31	1	00	6	505
July	2	390	1	93	2	598	2	445	1	904	2	01	2	173	2	339
August		020	0	85		131		505		525	3	07	0	0	4	269
September	2	100	1	65	2	043	3	140	1	579	2	16	0	67	1	090
October	2	460	2	94	2	424	1	670	1	103		61	2	52	5	254
November	1	570	1	93	2	065		915		831	2	97	2	91	0	534
December	1	500		81	1	322		890	1	105	2	09	3	22	0	894
Total.	21	,495	21	,0	22	,924	18	,360	14	,646	25	,75	24	,336	34	,300

Mr. Hadley *makes the following Remarks.*

1. He obſerves on the barometrical tables of theſe two year *viz.* 1729, and 1730, that they confirm former remarks mad by Dr. *Derham*, and others, of the agreement of the barom ters in places at a good diſtance from each other: Not on the monthly mean heights agree in the three diaries of th aforeſaid two years in *England*, but alſo the greateſt aſce and deſcent of the mercury happen commonly on the ſam day; and the barometers have been found to agree in the motions to an hour, ſo far aſunder as *Townley* in *Lancaſhir* and *Greenwich* near *London*, which is near 160 miles, th that might be partly accidental. The barometer at *Cran Court* and *Southwick*, diſtant about 55 miles, being compar' ſeem very ſeldom to vary from their mean difference, abo $\frac{1}{10}$ and a half each way; at *Southwick* and *Kent*, ſomethi more. From whence it might be expected that the weath ſhould be much the ſame in all theſe places; which neverth leſs ſeems not to agree with accounts, in ſome years, from di ferent parts in this iſland, not very far diſtant: And Mr. *Ha ley* himſelf has ſometimes obſerved clouds to lie in one pa of the horizon for a great part of a day, which have diſcharg a large quantity of rain, in places not far off, while the plac where he has been, has all the while enjoy'd fair weathe and *vice verſâ.* Whence it appears, that the barometrical a terations of the air extend farther than their effects, as to t production of rain at thoſe times. Comparing the Diaries *Crane-Court* and *Upſal*, he finds the barometers vary from t mean difference an inch and a half each way; *Crane-Cou* and *Padua* as much, or more, and often go a pace quite co trary at the ſame time; and their monthly differences are a ſo very variable; ſo that their agreement at any time ſee to be but accidental.

2. He obſerves, that the deſcents of the mercury below t mean heights of each place, taken in this way of Dr. *Juri* are generally much greater than the aſcents of it above; a there are alſo, in every year, other extraordinary deſcents the mercury, of the ſame kind. The reaſon he takes to this; namely, becauſe the expanſion of the air, whereby becomes lighter in ſome one place, being the original of t alterations in the atmoſphere, its effects by condenſation accumulation of the air in the places round about will be mo diſperſed; and therefore leſs ſenſible.

3. Th

3. The variation or range is greater the farther north, as has been heretofore obſerved, and appears in theſe tables, in which he has put the Latitude of each place; and likewiſe it is generally greater in the winter than in the ſummer months. The Sum of the motion of the mercury upwards and downwards, taken from the *Berlin* wand'ring line, with a pair of compaſſes, in 1726, amounts to about 76 inches; which gives 5 $\frac{1}{3}$ for a month, and about 0, 21 for each day: but the barometer is by much moſt ſteady in ſummer.

4. The mean height of the barometer hath already been applied to determine the reſpective heights of places, and likewiſe the abſolute height above the ſurface of the ſea. Dr. *Scheuchzer*, in his tables, publiſhed in *Phil. Tranſ.* N° 405, 406, ſuppoſes, from M. *Mariotte*, the mean height at the ſurface of the ſea, to be 28″ 1‴, *Paris* meaſure, which reduced to *Engliſh*, gives 29,993 inches. This agrees very well with a diary, communicated to the *Society*, containing 10 months of the year 1723, and *January* 1724; the author of which found by experiment, that in the place where his barometer was kept, the mercury ſtood $\frac{1}{10}$ and $\frac{1}{2}$ higher than at the ſurface of the ſea, which was not far from the place of his habitation. The mean height of the barometer for thoſe 10 months (leaving out the *January* following, which ſeems to be a very irregular month) Mr. *Hadley* finds to be 29,825, to which adding $\frac{1}{10}$ $\frac{1}{2}$, it will give the mean height at the ſurface of the ſea 29,975: So that the difference between theſe is only 0,018; and therefore, probably, may be near the truth, but may hereafter be more exactly determined by experiments. Then allowing about 90 feet, or rather leſs, for each 10th of an inch in the height of the mercury in ſmaller altitudes, or in greater according to the tables calculated for that purpoſe by Dr. *Scheuchzer* and Dr. *Nettleton*, and publiſh'd in *Phil. Tranſ.* N° 388. you will have the height of each place pretty near, provided the obſervations be carefully made, and continued for a ſufficient time: For, the yearly mean heights in one of the places in theſe tables appear to differ near $\frac{1}{10}$ of an inch in theſe two years: And in moſt of them, the laſt of theſe two years exceeds the firſt, two or three hundredth parts; the barometer alſo ought not to be removed to a lower or higher place.

As to the thermometrical tables, and thoſe of the rain, Mr. *Hadley* only remarks, that the thermometers agree, eſpecially

cially as to the hottest days in the year, more than might be expected from places at such a distance.

The winds are of so uncertain and variable a nature, that they require a more than ordinary care and diligence in making the observations, and a great length of time, and a comparison of a vast number of them, before any thing can be deduced more than is commonly known; and therefore Mr. *Hadley* only gives this hint, namely, that if the observers would take particular notice, in great storms, of the time when the mercury first begins to rise, whether before or after, or in the very height of the storm, it might be a direction to judge, when an abatement or increase of it might be expected (if any regular order should be found therein) which might be serviceable on some occasions. But if any attempts should be made to lay down any thing certain concerning the rise and progress of the variable winds, it will appear, by considering the cause of the trade-winds, that on the same account the motion of the air will not be naturally in a great circle, for any considerable space, upon the surface of the earth any where, unless in the equator itself, but in some other line: And in general, all winds, as they come nearer the equator, will become more and more easterly; and as they recede from it, more and more westerly, unless some other causes intervene.

By the continuance of this method, in process of time, a discovery may be made of some regular course in these things, which may be of use.

A Solar Eclipse, observed in Fleet-street, London, Feb. 18, 1737; *by Mr.* George Graham. Phil. Transf. N° 447. p. 175.

Apparent Time.

	Ho.	Min.	Sec.	
At	2	25	9	p. m. a small impression appear'd on the sun's limb. Mr. *Graham* judges the beginning to have been about 5 or 6 seconds sooner.
	3	21	28	The middle of the first and larger spot cover'd.
		29	30	The middle of the smaller spot cover'd.
		40	4	The cusps perpendicular.
	4	3	34	The cusps horizontal.
		35	32	The middle of the larger spot emerged.
		38	21	The smaller spot emerged, or a little before.

Apparent

Apparent Time.

Ho	Min.	Sec.		
4	52	57	The chord between the cuſps —	1057
	55	0	The chord — — —	954
	56	32	The chord — — —	851
	59	34	The chord — —	632

Then a cloud cover'd the upper limb, and intercepted the view of the ending, which was ſoon after.

Between 12 and 1 o' clock, Mr. *Graham* meaſured the ſun's diameter, with a micrometer.

At the time of the greateſt obſcuration, the lucid part of the ſun's diameter was equal to 392 ſuch parts as his whole diameter contain'd 2188.

Mr. *Graham* had a tranſit of the ſun at noon, and of *Sirius* at night; which, compared with preceding tranſits, he found his clock went about one ſecond in a day too faſt for mean ſolar time.

The ſame Eclipſe obſerved at the Royal Obſervatory, *at* Greenwich, *in company with Dr.* Halley, *by Dr.* Bevis. Phil. Tranſ. N° 447. p. 176.

Apparent Time.

Ho.	Min.	Sec.	
At 2	25	39	p. m. The beginning.
5	3	29	The end.

At the end, the ſun's limb appear'd ſomewhat tremulous, and a ſmall thin cloud came over it. Dr. *Bevis* judged the time might be relied on to two or three ſeconds.

The ſame Eclipſe obſerved at Edinburgh, &c. *by Mr.* Colin Maclaurin. Phil. Tranſ. N° 447. p. 177.

In the hiſtory of eclipſes, collected by *Riccioli*, there are very few ſaid to be annular; and of theſe ſome have been controverted, as that ſeen by *Clavius*, at *Rome*, *April* 9. 1567, and that ſeen by *Jeſſenius*, at *Torgau* in *Miſnia*, *Feb.* 25, 1598; which are both diſputed by *Kepler*.

Some Aſtronomers, both ancient and modern, have been of opinion, that no eclipſe can be annular: And ſince ſuch ſeem to have been rarely obſerved, and Mr. *Maclaurin* has not met with a particular deſcription of any of them, he gives as full an account of this eclipſe, as he can collect from the obſervations made at *Edinburgh*, and thoſe communicated to him from the country.

During

During the eclipſe, the ſky was generally favourable in th
ſouthern parts of *Scotland*; and tho' there were great ſhowe
of ſnow in the north, they had ſometimes a view of it. Ther
was ſomething very entertaining in the annular appearance
a phenomenon equally new to all who ſaw it, that gave gre
delight to the curious, without ſtriking terror into the vulga
It extended ſouthwards almoſt to *Morpeth* in *Northumbe*
land, and beyond *Inverneſs* northwards: So that a part
England, and almoſt all *Scotland*, were within its limit
Mr. *Maclaurin* had not hitherto learned how far the north l
mit was from *Edinburgh*; but he was inform'd, that th
weather was very unfavourable there.

Ten days before the eclipſe, Mr. *Maclaurin* wrote to ſev
ral of his acquaintance in the country, deſiring that they woul
determine the duration of the annular appearance as exactl
as poſſible, in hopes, by comparing their obſervations, to ha
traced the path of the centre, and the limits of this phenom
non after the example given in 1715 by Dr. *Halley*, to whon
we owe the beſt deſcription of an eclipſe that aſtronomical h
ſtory affords. Mr. *Maclaurin* gives an abſtract of the accoun
he receiv'd in anſwer to theſe letters, after firſt deſcribing th
obſervations at *Edinburgh*.

The times of the appearance at *Edinburgh* were determin
by a *pendulum* clock of Mr. *Graham*'s; from whom likewi
Mr. *Maclaurin* had the meridian inſtrument by which it
examined. The meridian line was often adjuſted in the uſu
manner; and an exact account of the tranſits of the ſun in th
meridian, and of *Procyon* in a fixt teleſcope, was kept by M
Short for a long time before and after the eclipſe: And b
comparing his obſervations, Mr. *Maclaurin* cannot doubt b
that the times were determined with ſufficient exactneſs; bein
often with him when he examined the meridian, and obſerv
thoſe tranſits; particularly the day of the eclipſe, when b
the ſun's tranſit in the meridian, it was found that the cloc
was before the apparent time 13 min. 27 ſec. and ſo much M
Maclaurin deducted from the times, that were mark'd durin
the obſervation.

The latitude of *Edinburgh* is commonly ſaid to be 55 de
grees 55 minutes; and by ſome trials, this muſt be near th
truth, tho' in ſome maps and tables it be repreſented great
By comparing an obſervation had at *Edinburgh* of the end
the lunar eclipſe, *Nov.* 20. 1732. with an obſervation of th
end of the ſame eclipſe by Mr. *Geo. Graham* at his houſe
Flee

Fleetstreet, *London*, the longitude of the former is a little more than 12 minutes of time farther west.

Some days before the eclipse the Lord *Aberdour* set up a clock in the castle of *Edinburgh*, and adjusted it with Mr. *Maclaurin*'s by a watch that shew'd the seconds. The clocks were both compared together the day of the eclipse at noon, by a cannon fir'd from the castle; some persons being appointed to attend each clock, and mark the seconds when they heard the sound (an allowance of two seconds and a half being made for the progress of the sound, which was determined by several trials at night) the clock in the castle was found to be before the apparent time 12 min. 19 sec. and so much is subducted from the times that were mark'd in the castle during the observation. It was agreed to give signals to one another mutually at the beginning and end of the eclipse, and at the beginning and end of the annular appearance, which was a cannon from the castle, and a musquet from the college, tho' no regard is had to these signals in marking the times of the appearances.

His Lordship made use of a reflecting telescope of 15 inches and a half focal distance, that magnified 90 times: only he observ'd the annular appearance with one of five inches and a half, that he might have a view of the whole disk of the sun at once. Mr. *Short* observ'd the beginning of the eclipse with a telescope of 15 inches and a half focal distance, that magnified 104 times; but the annular appearance with one of the same length, that also took in the whole disk of the sun, and magnified 50 times. The reflecting telescope, with which Mr. *Maclaurin* observ'd the eclipse from the beginning to the end, took in the whole disk of the sun (having been made by Mr. *Short* for this purpose) tho' the focal distance of the big speculum was nine inches and a half; and tho' it bears a higher charge, he made use of an eye glass on this occasion, that magnifies only 50 times.

By a computation made at *Edinburgh* from Sir *Isaac Newton*'s theory, Mr. *Maclaurin* expected the eclipse would begin at two hours six minutes apparent time: they therefore look'd attentively towards the south-west part of the sun's limb from two o'clock. At two hours five minutes 36 seconds was perceiv'd a depression that was just discernable on the sun's limb near that place; the signal at the college was then made, but by an accident my Lord *Aberdour* had been hinder'd from observing the sun at that time: However when he look'd for it he saw it was begun, and his signal gave general intimation

 of

of this to the town, about 40 seconds after they had first perceiv'd it at the college; and as far as Mr. *Maclaurin* learned it was not discerned by the eye, tho' assisted with a smoak'd glass, till about this time.

Mr. *Maclaurin* observ'd the progress of the eclipse by helioscope; but after 10 digits were eclipsed, he returned to the telescope, to attend the beginning of the annular appearance. A little before the annulus was compleat, a remarkable point or speck of pale light appeared near the middle of the part of the moon's circumference, that was not yet come upon the disk of the sun; and a gleam of light, more faint than this point seem'd to be extended from it to each horn: He did not mark the precise time when he first peceiv'd this light, but he is satisfied that it could hardly be less than one fourth of a minute before the annular appearance began. Mr. *Short* (who was in another chamber at some distance, and made use of a larger telescope) assured Mr. *Maclaurin* that he saw it 20 seconds before the *annulus* was compleated.

Mr. *Maclaurin* was surpriz'd with this light at first; and did not immediately recollect, that it proceeded probably from the same crown that was seen about the moon in a total eclipse of the sun at *Naples* in 1605; and was observ'd by several persons in different parts of *Europe* in the three late total eclipses of 1706, 1715, and 1724. He did not expect to have seen this light, when so much of the sun's disk was uncover'd; but as he kept in the telescope only so much of the disk as was necessary for ascertaining the time of the formation of the *annulus*, this must have contributed to his discovering it: For, this light was very faint, compared with what appeared on the sun's arch near the same place the moment it was uncover'd, and the *annulus* compleated.

Most of those, who observ'd the eclipse with telescopes, mention in their letters to Mr. *Maclaurin*, that as the *annulus* was forming, they perceiv'd the light to break in several irregular spots near the point of contact, and that the moon's limb seem'd to be indented there. Some express themselves, as if those irregular parts had appeared to them in a kind of motion.

In a letter to lord *Aberdour*, it is described by Mr. *Bayne* professor of the municipal law in the following manner:

'What appeared to me most entertaining, *says he*, consider'd as an object of sight was, when the extremities of the horns, formed upon the face of the sun, seem'd, as if they had been in the action of uniting their points, the inequalities on

'th

the extremity of the moon's disk exhibited the appearance as of ſmall bodies in particular motion.'

There was not any undulation at this time on the circumfe-nce of the ſun. Mr. *Maclaurin* finds that ſuch appearances f a tremulous motion in certain periods of ſolar eclipſes are ention'd by *Hevelius* and others.

Lord *Aberdour* obſerv'd the beginning of the annular ap-earance with a ſmaller teleſcope, and perceiv'd only a narrow reak of a dusky red light to tinge the dark edge of the oon, immediately before the ring was compleated, and after t was diſſolv'd.

At three hours, 25 minutes, 55 ſeconds, the circumference of e ſun appeared compleat, and perfectly circular. At the ſame ſtant the ſignal from the caſtle was made, and in a ſecond or wo the cannon from the caſtle was heard. The *annulus* appear'd the eye to be central for ſome time; but in the teleſcope it as always breader towards the ſouth eaſt than towards the orth-weſt part of the ſun's disk. The breadth appeared much eater to the naked eye than could have been expected from the ifference of the ſemi diameters of the ſun and moon. This as ſo remarkable, that ſuch a phenomenon muſt have con-rmed thoſe aſtronomers in their opinion, who imagined that e diameter of the moon is contracted in her conjunctions with e ſun. This appearance proceeded chiefly, Mr. *Maclaurin* ppoſes, from the light's incroaching on the ſhadow, as is ſual: But whatever was the cauſe, every body ſeem'd ſurpriz'd at the moon appear'd ſo ſmall upon the ſun's disk.

It was obſerved that the motion of the moon appear'd more uick in the formation and diſſolution of the *annulus*, than dur-g its continuance. This is particularly deſcrib'd by Mr. *Ful-rton* in a very exact account of the eclipſe, as it appear'd at is ſeat, at *Crosby*, near *Air*, on the weſt coaſt of *Scotland*.

'The *annulus* appear'd to be nearly of an uniform breadth during the greater part of the time of its continuance, but ſeem'd to go off very ſuddenly: So that when the diſk of the moon approach'd to the concave line of the ſun's diſk, they ſeem'd to run together like two contiguous drops of water on a table when they touch one another;' *and he adds*, 'that it came on in the ſame way.'

This appearance ſeems to be accountable from the ſame opti-l deception as the former.

During the appearance of the *annulus*, the direct light of e ſun was very conſiderable; but the places, ſhaded from his

light, appear'd gloomy. There was a duſk in the atmoſphe
eſpecially towards the north and eaſt. In thoſe chambers th
had not their lights weſtwards, the obſcurity was conſiderab
Venus appear'd plainly, and continued viſible long after t
annulus was diſſolv'd; and Mr. *Maclaurin* was told that oth
ſtars were ſeen by ſome: One Gentleman is poſitive, that bei
ſhaded from the ſun, he diſcerned ſome ſtars northward
which he thinks by their poſition were in *Urſa major*.

It was very cold at this time; a little thin ſnow fell, a
ſome little pools of water in the College area, where there w
no ice at two o'clock, were froze at four. A reflecting teleſco
of a large ſize, and of a much greater aperture than ordinar
that took in the whole ſun, and burned cloth very quickly thr
the tinged glaſs at the beginning of the eclipſe, and on that a
count could not then be us'd with ſafety, was that by whi
Mr. *Short* obſerv'd the annular appearance. Some curio
Gentlemen found, that a common burning glaſs, which kindl
tinder at 3 hours 59 minutes, and burned cloth at 4 hours 8 m
nutes, had no effect during the annular appearance, and f
ſome time before and after it.

Thoſe things Mr. *Maclaurin* mentions moſtly on the repo
of others: For, during the greater part of this appearance
was obſerving thro' the teleſcope the progreſs of the moon upo
the ſun's diſk.

The firſt internal contact of the diſks, at the formation
the *annulus*, was conſiderably below the weſt point of the ſu
diſk; and the ſecond contact, at the diſſolution of the *annulu*
ſeem'd to be about 10 degrees eaſtwards from the north point
zenith of the diſk: But he did not find that the poſition
thoſe points of contact could be eſtimated with exactneſs on ſ
veral accounts. The breadth of the *annulus* towards the ſou
eaſt part of the ſun's diſk was at leaſt double its breadth towar
the oppoſite part, about the middle of this appearance. A
apparatus, by which he was in hopes of being able to dete
mine thoſe things more accurately, was not ready. He pr
pos'd to have made ſome eſtimation of the ratio of the co
tinuance of the annular appearance, where it was central to i
continuance at *Edinburgh*, from that of the arithmetical me
betwixt the numbers that ſhould expreſs the proportion of th
greateſt and leaſt breadth of the *annulus* to the geometric
mean betwixt the ſame numbers; or from the ratio of the r
dius to the ſine of half the arch, intercepted between the tw

poin

points of internal contact: But he did not obtain these ratio's with sufficient exactness.

At 3 hours 31 minutes 43 seconds, the *annulus* was dissolv'd, after having continu'd 5 minutes, 48 seconds: And here again the signals were heard immediately after one another. The middle of the eclipse was, therefore, at 3 hours, 28 minutes, 49 seconds. In this the time of observation did not agree so well with the time by computation, as in the beginning of the eclipse, the difference being here about four minutes. The irregularities of the moon's surface occasion'd the same appearances, in some measure, as at the formation of the *annulus*.

When Mr. *Maclaurin* returned to the helioscope, there was some time lost in directing it towards the sun; and when he got the image in a due position, there was less than eleven digits eclipsed; and he suspects that it never amounted to full eleven digits. He had no micrometer.

After taking some more digits, he went with Sir *John Clerk* to a neighbouring house, to observe the end of the eclipse. By a signal that was made to the person who attended the clock (two seconds being subducted, that were lost in making the signal) the end was at 4 hours 44 minutes 51 seconds. The wind blew hard at this time; so that the telescope could not be kept very steady, and there was some undulation on the circumference of the sun: But Mr. *Maclaurin* cannot think that the error of this observation can exceed three or four seconds, the circumference of the sun appearing to him complete at that instant.

Mr. *Maclaurin* now subjoins the observations made in the Castle and College in one view; whereby it appears that they agree precisely as to the continuance of the annular appearance (a coincidence that could not have been expected) according to the numbers taken by those who attended the clocks.

	In the College			In the Castle		
	H.	M.	S.	H.	M.	S.
The beginning of the eclipse at	2	5	36			
The beginning of the annular appearance	3	25	55	3	25	53
The end of the annular appearance	3	31	43	3	31	41
The end of the eclipse	4	44	51	4	44	48

By

By Lord *Aberdour*'s obſervations, the lowermoſt and large[st]
of the two ſpots that appear'd upon the upper part of th[e]
ſun's diſk, was touch'd by the moon at 3 hours, 4 minute[s]
40 ſeconds; and this ſpot was entirely cover'd at 3 hours 5 mi-
nutes, 19 ſeconds. Mr. *Short* obſerv'd another ſpot at the cir-
cumference of the moon, at 2 hours, 24 minutes, 51 ſeconds.

Tho' the obſervations of the digits could not, on ſeveral ac-
counts, be made with ſo much exactneſs, as the precedin[g],
Mr. *Maclaurin* ſubjoins ſome of them

		H.	M.
The ſun was eclipſed	2 digits at	2	21
	6 dig.	2	50
After the annular appearance	9 dig.	3	45
	8 dig.	3	52
	7 dig.	3	59
	6 dig.	4	6

At *Hopeton-houſe*, 9 miles weſt, and a little northwar[d]
from *Edinburgh*, the Lord *Hope* obſerv'd the annular appear-
ance to begin at 3 hours, 25 minutes, the end of this appear-
ance at 3 hours, 31 minutes; and the end of the eclipſe a[t]
4 hours, 44 minutes and a half. His Lordſhip was obliged [to]
obſerve the eclipſe at a diſtance from the clock, and to deter-
mine the times by a pocket-watch, that had been adjuſted by [a]
very good dial that day at 12 o'clock; but he aſſur'd Mr. *Ma-
claurin*, that the duration of the annular appearance was ſi[x]
minutes, as near as could be judged by a watch that did no[t]
ſhew the ſeconds. The moon appear'd to touch the larger ſpo[t]
above-mentioned at 3 hours, 4 minutes, and cover'd it in abou[t]
half a minute. The emerſion of the ſame ſpot was at 4 hour[s]
13 minutes. A leſſer ſpot, higher on the ſun's diſk, was no[t]
cover'd till 11 minutes after the greater ſpot, but appear'd ra-
ther ſooner than it.

At *Crosby*, on the weſt coaſt of *Scotland*, about 4 miles nort[h]
from *Air*, Mr. *Fullerton* obſerv'd the eclipſe to begin [at]
2 o'clock. A diſtinct *annulus* was formed about 20 minute[s]
after three, which continu'd exactly ſeven minutes, meaſur'd b[y]
a pendulum vibrating ſeconds. It appear'd rather broader [at]
the lower verge of the ſun; but the difference muſt have bee[n]
very ſmall: For, it was but bare diſcernible in a ſpecies of th[e]
eclipſe ſix inches over, caſt on a piece of paper behind the eye-
piece of a teleſcope ſix foot long. He adds, that the day-ligh[t]

wa[s]

as not greatly obscur'd, appearing only so much dimmer than ual, as that of the sun is, when seen thro' a very gentle mist a fine morning in *April* or *May*.

Sir *Thomas Wallace* found that the annular appearance con- nued at his house near *Lockryan* in *Galloway* five minutes.

From the observation at *Crosby*, the centre of the annular *numbra* seems to have enter'd *Scotland* not far from *Irwine*. proceeded afterwards towards the east, with a considerable clination northwards; and probably left *Scotland* not far om *Montrose* on the east coast: For, Mr. *Auchterlony* found at the annular appearance continu'd there seven minutes, as ar as he could judge by a common watch. The *annulus* kewise appeared to him of an uniform breadth, thro' a com- on telescope. This observation, tho' not so exact as that at *osby*, is however confirmed by that at St. *Andrews*, which all be mention'd hereafter.

These two observations at *Crosby* and *Montrose* were made arer the path of the centre, than any others that were commu- cated to Mr. *Maclaurin*.

As to the southern limit of this appearance, the eclipse was t annular at *Newcastle*; and there wanted about 40 degrees the sun's limb to appear in order to form an *annulus*, accord- g to the observation of Mr. *Isaac Thomson*.

The whole duration of the eclipse was 50 seconds less by . *Thomson*'s observation than by that made at *Edinburgh*; d the larger spot was hid 1 hour, 9 minutes, 35 seconds by observation: The digits eclips'd at its immersion were 7,7; its emersion 4,1.

The eclipse was not annular at *Morpeth*; from whence . *John Wilson* writes, that the body of the moon appear'd nost entirely on that of the sun; and that to the naked eye, disk of the sun seem'd to be almost round.

But of all the observations that were communicated to . *Maclaurin*, that of Mr. *Long* at *Longframlington* (seven nputed miles on this side of *Morpeth*) determines the sou- rn limit with the greatest exactness. The *annulus*, he says, s very small there upon the upper part, and the duration 40 41 half seconds, measur'd by a pendulum 9,81 inches long; n which we may conclude, that the limit was very near this ce. This curious observation, with several others, was unicated by Mr. *Mark* at *Dunbar*.

Mr. *Maclaurin* receiv'd no accounts concerning this appear- e from any places on the west coast of *England*.

At

At *Alnwick* in *Northumberland* the eclipſe was annula
but he had not heard that the time of its continuance w
meaſur'd.

At *Berwick* the annular appearance continued betwixt 4 an
5 minutes.

The end of the eclipſe at *Dunbar*, by Mr. *Mark*'s obſerva
tion, was at 4 hours, 48 minutes, 16 ſeconds; but there wa
ſome miſtake committed in reckoning the vibrations of the pe
dulum in meaſuring the continuance of the *annulus*.

At St. *Andrews*, Mr. *Charles Gregory* and Mr. *Davi*
Young, Profeſſors in the Univerſity, obſerv'd this appearance
continue preciſely ſix minutes, by a pendulum clock. By
figure of the *annulus*, taken from its image, projected thorou
a teleſcope upon a paper ſcreen, the breadth towards the ſout
eaſt part of the ſun's diſk is rather more than double its bread
towards the oppoſite part.

The obſervation at *Montroſe* has been mention'd above.

At *Aberdeen* the *annulus* was obſerv'd by Mr. *John Stewar*
Profeſſor of Mathematics, for three minutes, two ſeconds:
was almoſt central, when the clouds depriv'd him of any fa
ther view of it; he thinks it probable, that it continued the
about ſix minutes. Several Gentlemen who live on the coa
northwards from *Aberdeen* were deſir'd to obſerve the con
nuance of the *annulus*; but Mr. *Maclaurin* does not find th
any of them ſaw this phenomenon from the beginning to t
end.

At *Elgin* the eclipſe was obſerv'd annular at 3 hours, 29 m
nutes (the larger part of the ring being uppermoſt) by Mr. *I*
win, who had a view of it for about 30 ſeconds; but by reaſ
of intervening clouds could not determine the beginning or e
of this appearance.

At *Caſtle-Gordon*, Mr. *Gregory* had one view of the eclip
while it was annular, but could make no farther obſervation
reaſon of clouds.

At *Inverneſs*, the eclipſe was annular for ſome minutes,
Mr. *Maclaurin* was informed by ſeveral Gentlemen; but th
did not meaſure the preciſe time of its continuance.

By the accounts Mr. *Maclaurin* had from *Fort Auguſtus* a
Fort William, it is doubtful, whether the eclipſe was annu
in thoſe places or not.

Fort Auguſtus is at the weſt end of *Lochneſs*, and probab
was not far from the northern limit of this phenomenon.

M

Mr. *Maclaurin* had hitherto receiv'd no accounts of this ap-
arance from any place farther northwards, or from any place
the weſt, but thoſe already mention'd. Some Gentlemen in
rgyleſhire, who obſerv'd this eclipſe, were depriv'd of a view
f the *annulus* by the clouds.

Mr. *Walker*, an ingenious Gentleman at *Frazerburgh* on the
rth coaſt, found, that from the time of the *ring*'s beginning to
ppear upon the lower and weſtern part of the ſun's diſk, till it
egan to break on the eaſt and upper part, there were 300 vi-
rations of a pendulum, or five minutes. The *ring* ſeem'd
mewhat narrower even at the middle of the eclipſe on the
wer part.

This is the ſum of what Mr. *Maclaurin* was able to learn
oncerning the obſervations of this eclipſe, made in *Scotland*,
d in the neighbouring parts of *England*.

He made ſome computations relating to the extent of the an-
lar *penumbra*, and the direction and velocity of its motion;
t as he had not a ſufficient number of exact obſervations, by
hich he might examine them, it would be of little uſe to de-
ribe them.

Had the weather been more favourable in the north, and had
r. *Maclaurin*'s requeſt of having the duration of the annular
ppearance meaſur'd, been made more publick before the
clipſe, after Dr. *Halley*'s example in 1715, he doubts not but
e ſhould have been able to have given a more exact account of
e progreſs of the centre of this phenomenon, and of its limits;
ut he was diſcouraged from publiſhing any thing concerning it,
y the bad fortune in ſeveral late eclipſes, of which the clouds
ad not allow'd the leaſt view.

Mr. *Maclaurin* was informed, that there was very little no-
ice taken of this eclipſe by the populace in the country; and
e cannot but add, that ſeveral Gentlemen of very good credit,
ho are not in the leaſt ſhort-ſighted, aſſur'd him, that about
he middle of the annular appearance they were not able to diſ-
ern the moon upon the ſun, when they look'd without a
moak'd glaſs, or ſomething equivalent.

Mr. *Maclaurin* takes notice of this; becauſe it may contri-
ute to account for what at firſt ſight appears ſurpriſing,
amely, that there are ſo few annular eclipſes in the liſts, col-
ected by authors.

Kepler in his *Aſtron. Optic.* does not ſeem to acknowledge,
hat any eclipſe, truly annular, had ever been obſerv'd.

There are none mention'd by *Riccioli* from the year 334 ti[ll] 1567; tho' there are 13 or 14 total eclipses recorded withi[n] that period: Yet it is allow'd that the extent and duration [of] the annular appearance may be considerably greater in th[e] former, than of the darkness in the latter. It may have contri[buted] to this, that annular eclipses must have been rather inc[i]dent in the winter season in the northern hemisphere, and th[e] eclipses have been more readily total in the summer, when the chance of being visible was greater, and the season more favou[r]able for observing them. But perhaps the chief reason, wh[y] few annular eclipses appear upon record, is, that in most cas[es] they have not been distinguish'd from ordinary partial one[s]. The darkness distinguish'd total eclipses, or such as were ver[y] nearly so; and it is these chiefly that historians mention.

There are two central eclipses of the sun still famous among the populace in *Scotland*; that of *March* 29, 1652 was tota[l] there, and that day is known amongst them by the appellatio[n] of *Mirk Monday*.

The memory of the eclipse of *Feb*. 25, 1598. is also pre[serv'd] amongst them, and that day they term, in their way, *black Saturday*. There is a tradition that some persons in th[e] north lost their way in the time of this eclipse, and perish'd [in] the snow.

There was a remarkable total eclipse of the sun in *Scotland* *June* 17, 1433. the memory of which is now lost amongst th[e] populace; but it appears from a passage in a manuscript in th[e] College-library at *Edinburgh*, that after their usual manner [it] was formerly call'd by them, the *black hour*. It is describe[d] thus:

'Hoc anno fuit mirabilis eclipsis solis, 17mo die mensis *Ju*-'*nii*, hora quasi tertia post meridiem; & per dimidium hor[æ] 'tenebræ tanquam in nocte supergressæ sunt superficiem terræ; 'ita ut nihil obtutibus humanis pervium fuit; unde abhin[c] 'vulgariter dicta fuit *hora nigra*.'

This eclipse is not in *Riccioli*'s catalogue, but is mention['d] by him in another place, *Schol. cap*. 2. *L*. 5.

By a computation of this eclipse, the sun was within tw[o] degrees of his *apogæum*, and the moon within thirteen degre[es] of her *perigæum*: So that this must have been a remarkab[le] eclipse. The progress of the shadow was towards the south east; and *Sethus Calvisius* cites the *Turkish* annals for its bein[g] total in some part of their dominions.

On *Feb*. 25. in the evening was look'd for the occultation o[f] *Aldebaran* by the moon; but the star passed by the uppe[r] horn

horn, without being hid, at a diſtance from it, that was by eſtimation nearly equal to the diſtance betwixt the neareſt part of the ſpots *Eudoxus* and *Ariſtoteles*.

An Account of the Obſervations of the Solar Eclipſe, made at Edinburgh, *on* Feb. 18. 1736-7. *by Sir* John Clerk. Phil. Tranſ. N° 447. p. 195.

THE 18th of *February*, 1736-7 was a very fine bright day for obſerving the eclipſe; and never was any thing of that kind, Sir *John Clerk* believes, obſerv'd with more exactneſs.

In ſeveral places for 10 miles round the city of *Edinburgh*, as well as in it, were ſome skillful perſons ſtationed for that purpoſe: Sir *John* happen'd to be in the caſtle, which is an eminence of at leaſt 5 or 600 feet in height, beſides a great aſcent from the level of the ſea to the foot of the rock, upon which it is ſituated.

Mr. *Maclaurin*, profeſſor of mathematics, had placed himſelf at a window in the college; others were ſent where the eclipſe, as was ſuppoſed, would be perfectly central, about 12 or 14 miles farther north.

A gun from the caſtle was fir'd at 22 ſeconds after 12, mean time (or 12 minutes, 22 ſeconds before 12, apparent time) upon which, by agreement, the clocks and watches of the obſervers were adjuſted.

A ſecond cannon was diſcharged preciſely when the eclipſe began, which was at five minutes, 36 ſeconds after two.

A third was diſcharg'd when the annular appearance began, which was 25 minutes, 55 ſeconds after three; its continuance was five minutes, 48 ſeconds.

A fourth cannon was fired at the end of the eclipſe, which was at 44 minutes, 50 ſeconds after four: all reckon'd by apparent time.

There were half a ſcore good reflecting teleſcopes to make theſe obſervations, and the calculations agreed perfectly; ſo that they may be depended upon as very exact.

This was not done as a matter of mere curioſity, but to aſſiſt in aſcertaining the motions of the moon on Sir *Iſaac* Newton's theory, upon which a good deal of the doctrine of the longitude will depend. Sir *Iſaac*'s calculation, as to the beginning of this eclipſe, was pretty right; but not ſo well as to its central appearance.

Two ſpots in the ſun appear'd very diſtinctly, as they enter'd under the moon's body; one was a little above the cen-

tral or horizontal line of the ſun, of the ſhape as repreſente in Fig. 7. Plate XI. The other was near the edge, on the eaſ quarter. The firſt, compar'd with the ſun's diameter, wa larger than the diſk of our earth; it was dark in the middl and certainly emitted no fire or light.

The edge of the moon appeared a little ragged or ſcabrou but not mountainous, becauſe of the ſun's light. There was n conſiderable darkneſs, only the ground was cover'd with a kin of a dark greeniſh colour. Two ſtars appear'd, the planet *Ve nus*, and another farther eaſtward.

This Account Sir *John* aſſures, is what may be depende upon.

Obſervations of the ſame Solar Eclipſe at Trinity-College Cambridge, *and at* Kettering; *by Mr.* Charles Maſon. Phil Tranſ. N° 447. p. 197.

	H.	M.	S.
The beginning by the clock — at	2	36	40
The end — —	5	14	12 exac

Digits	The Eclipſe obſerved. Increaſing. H.	M.	S.	Decreaſing. H.	M.	S.
0½	2	39	30	5	11	50
1	2	43	0	5	9	0
1½	2	46	40			
2	2	50	25			
2½	2	54	15	4	59	30
3	2	58	5			
3½	3	1	55			
4	3	5	50			
4½	3	9	50			
5	3	14	0	4	42	55
5½	3	18	10	3	39	10
6	3	22	20	4	35	20
6½	3	26	30			
7	3	30	40	4	27	40
7½	3	34	50	4	23	55
8	3	39	30	4	20	10
8½	Clouds.			4	16	30
9				4	13	0
9½				4	10	10
10				4	7	50

The

	H.	M.	S.
The leſſer ſpot immerged — at	2	58	50
The greater ſpot begun to immerge —	3	33	5
The middle	3	33	20
The end	3	33	37

Times obſerved at *Kettering*, as follows:

	Ho.	Min.
The beginning — —	2	21
2 Digits — — —	2	36
Centre — — —	3	7
	4	22
End — — —	4	59
Great ſpot immerged —	3	18

N. B. The obſervatory clock was one minute 50 ſeconds too ſlow, which, being added all the way, will give true time.

Moſt of the preceeding obſervations are tolerably exact; but the wind, and other difficulties, make ſome of them a little precarious. The time is nearly true, if the error be corrected depending upon the truth of a meridian teleſcope.

A Solar Eclipſe obſerv'd on the 1ſt of March 1737, *N. S. at the Obſervatory of* Bononia. Phil. Tranſ. N° 447. p. 199. *Tranſlated from the* Latin.

THE beginning of this eclipſe preceded the calculation upwards of ſeven minutes of time: For, at three ho. 33 min. 36 ſec. ſome part of the edge of the ſun, when view'd through a ſmoak'd glaſs that was fitted to an 11 foot teleſcope, appeared to be indented by the moon, when a little before, namely, at 33 ſeconds, the ſun appeared quite round through the ſame teleſcope: But the calculation made the beginning at 3 ho. 41 min.

Afterwards the digits eclipſed were obſerv'd by tranſmitting a ray of the ſun through a ſix foot teleſcope, and receiving it on a white ſcreen, on which was drawn a circle commenſurate to the image of the ſun, and divided into digits and half digits: But the wind ſhaking the machine did not a little mar the obſervation. The more certain phaſes ſeem to be thoſe that follow:

3 10

H.	M.	
3	40	About a digit eclipsed
3	48	Two digits
3	57	Three dig.
4	6	Four dig.
4	$15\frac{1}{2}$	Five dig.
4	35	Seven digits
4	45	Seven digits and a half; which seem'd to be th greatest obscuration.
4	55	Again seven dig. the eclipse now decreasing.

Afterwards when the species of the sun, inclining to th west, was seen too tremulous and fluctuating, as also prett evidently turn'd oval from a round figure, measuring the di gits, was forbore as a thing not sufficiently certain

Some maculæ appear'd in the sun, particularly three, whos positions taken from the observations made that day at noon are represented in Fig. 8. Plate XI.

With the above-mentioned telescope of 11 foot, the occulta tions of two of them were determined, as follows:

Ho.	Min.	Sec.	
4	23	18	The moon's limb touches the coronna of th *macula* A
	23	49	It begins to cover the *nucleus* of the *macul* A
	24	25	It hides the whole *nucleus*.
	26	14	It just touches the *macula* B.
	26	31	It entirely covers it.

The same Eclipse observed from the Aventine Hill at Rome *by the* Abbé de Revillas. Phil. Transf. N° 447. p. 20 *Translated from the* Latin.

THE sun's species, transmitted through a telescope o *Campani*'s, six foot in length, was received upon a whit screen, on which was drawn a circle equal to the species, an divided into 12 digits: The phases observ'd in this manner ar as follows:

H.	M.	S. p. m.
3	43	4 The sun's limb is now found to be a little obscur'd by that of the moon.
	51	50 One digit eclipsed
4	0	40 Two digits
	9	30 Three dig.
	18	20 Four dig.
	27	10 Five digits.
	36	0 Six dig. while the limb of the moon touches the centre of the sun, thick clouds intercept the view of both luminaries, and of the following phases of the eclipse.

A partial Eclipse of the Sun, observed at Wittemberg *in* Saxony, Mar. 1. 1737. N. S. *by M.* Weidler. Phil. Trans. N° 447. p. 201. *Translated from the* Latin.

M. *Weidler* observ'd the phases of the emersion, as represented in Fig. 9. Plate XI.

			H.	M.	S.	
VIII	Dig. eclipsed at	—	4	50	31	p. m.
VII ¾	—	—		58	16	
VII ½	—	—	5	1	56	
VII ¼	—	—		5	26	
VII	—	—		8	16	
VI½	—	—		10	16	The sun

afterwards inclining to the west became overcast.

The beginning of the eclipse could not be seen by reason of clouds.

A Proposal to make the Poles of a celestial Globe move in a circle round the Poles of the Ecliptic; by Dr. Ebenezer Latham. Phil. Trans. N° 447. p. 201.

DR. *Latham* communicated to the *Royal Society* the following proposal, relating to an improvement in the construction of the globes of the heavens.

As we now have them, they are formed for the present age only, and do not serve the purposes of chronology and history, as they might, if the Poles on which they turn were contriv'd to move in a circle round those of the ecliptic, acording to the present obliquity of the latter. By this means we might have a view of the heavens suited to every period, and that would answer the antient descriptions, those of *Eudoxus*, for instance, who is supposed to have borrowed his from the most early observations; and of *Hipparchus*, &c. Nor could

could any contrivance better enable the meanest reader to judge of the merits of the controversy about the *Argonautic* expedition, as far as it depends on this: For, it will verify to the sight the place of the colures, &c. at any time.

The Equator in the Doctor's method must be fix'd to the brazen meridian, &c.

N. B. That globes, to answer the end here proposed, tho' differently constructed, had long before been made and publish'd by Mr. *Senex*, who gave in to the *Royal Society* the following account of his contrivance.

A contrivance to make the Poles of the diurnal Motion in a Celestial Globe pass round the Poles of the Ecliptic; by Mr. John Senex. Phil. Transf. N° 447. p. 203.

THE poles of the diurnal motion do not enter into the globe, but are affix'd at one end to two shoulders or arms of brass, at the distance of 23 deg. and ½ from the poles of the ecliptic. These shoulders at the other end are strongly fasten'd on to an iron axis, which passeth thorough the poles of the ecliptic, and is made to move round, but with a very stiff motion: So that when it is adjusted to any point of the ecliptic, which you desire the equator may intersect, the diurnal motion of the globe on its axis will not be able to disturb it.

When it is to be adjusted for any time past or to come, bring one of the brazen shoulders under the meridian, and holding it fast to the meridian with one hand, turn the globe about with the other in such manner, that the point of the ecliptic, which you would have the equator to intersect, may pass under no degrees of the brazen meridian: Then holding a pencil perpendicular to that point, and turning the globe about, it will describe the equator, as it was posited at that time; and transferring the pencil to 23 degrees and ½, and 66 degrees and ½ on the brasen meridian, the tropics and polar circles will be describ'd for the same time.

By this contrivance the celestial globe may be so adjusted, as to exhibit not only the risings and settings of the stars, in all ages, and in all latitudes, but the other phenomena likewise, that depend upon the motion of the diurnal axis round the annual one.

a a a a (Fig. 10. Plate XI.) represents a section of the celestial globe.

E E a strong iron axis, passing thro' the poles of the ecliptic.

be

bc two strong arms of brass, screw'd on to the ends of the iron axis at *d*.

PP the axis or poles of the diurnal motion (by which the globe is hung in the brasen meridian) rivetted on to the other ends of the brass arms, and which may be carried round the poles of the ecliptic, by the iron axis; but with so stiff a motion, as not to disturb the diurnal rotation on the poles PP.

The Solution of Kepler's Problem; *by Mr.* Machin. Phil. Transf. N° 447. p. 205.

SEVERAL attempts have been made at different times; but if Mr. *Machin* mistake not, never any hitherto with tolerable success, towards the solution of the problem, propos'd by *Kepler*; namely, *to divide the area of a semicircle into given parts by a line from a given point of the diameter, in order to find an universal rule for the motion of a body in an elliptic orbit.*

For, among the several methods offer'd, some are only true in speculation, but are really of no service; others are not different from *Kepler*'s own, which he judged improper: And as to the rest, they are all some way or other so limited and confined to particular conditions and circumstances, as still to leave the problem in general untouch'd.

To be more particular, it is evident, that all constructions by mechanical curves are seeming solutions only but in reality unapplicable; that the roots of infinite series's are, on account of their known limitations in all respects, so far from affording an appearance of being sufficient rules, that they cannot well be suppos'd as offer'd for any thing more than exercises in a method of calculation: And then as to the universal method, which proceeds by a continued correction of the errors of a false position, it is, when duly consider'd, no method of solution at all in itself; because unless there be some antecedent rule or hypothesis to begin the operation (as suppose that of an uniform motion about the upper *focus*, for the orbit of a planet; or that of a motion in a parabola for the perihelion part of the orbit of a comet; or some other such) it would be impossible to proceed one step in it.

But as no general rule has ever hitherto been laid down, to assist this method; so as to make it always operate, it is the same in effect, as if there were no method at all. And accordingly in experience it is found, that there is no rule now subsisting but what is absolutely useless in the elliptic orbits of comets:

comets: For, in such cases there is no other way to proceed but that which was made use of by *Kepler*; namely to compute a table for some part of the orbit; and therein examine if the time, to which the place is requir'd, will fall out any where in that part. So that, upon the whole, Mr. *Machin* thinks it evident, that this problem (contrary to the received opinion) has never hitherto been advanced one step towards its true solution; a consideration which will furnish a sufficient plea for meddling with a subject so frequently handled; especially if what is offer'd shall at the same time appear to contribute towards supplying the main defect.

Lemma 1. The tangent of an arch being given, to find the tangent of its multiple.

Let r be the radius of the circle, t the tangent of a given arch A, and n a given number; and let T be the tangent of the multiple arch $n \times A$ to be found.

Then if $\rho\rho$ be put for $-rr$ and $\tau\tau$ for $-tt$.

$$\text{The tangent T will be } \frac{\overline{r+\tau}|^{n} - \overline{r-\tau}|^{n}}{\overline{r+\tau}|^{n} + \overline{r-\tau}|^{n}}\,\rho$$

Which binomials being rais'd according to Sir *Isaac Newton*'s rule, the fictitious quantities τ and ρ will disappear, and the tangent T will become equal to

$$\frac{nt - \frac{n}{1}\cdot\frac{n-1}{2}\cdot\frac{n-2}{3}\cdot\frac{t^3}{r^2} + \frac{n}{1}\cdot\frac{n-1}{2}\cdot\frac{n-2}{3}\cdot\frac{n-3}{4}\cdot\frac{n-4}{5}\cdot\frac{t^5}{r^4} - \&c.}{1 - \frac{n}{1}\cdot\frac{n-1}{2}\cdot\frac{tt}{rr} + \frac{n}{1}\cdot\frac{n-1}{2}\cdot\frac{n-2}{3}\cdot\frac{n-3}{4}\cdot\frac{t^4}{r^4} - \&c.}$$

This theorem (which Mr. *Machin* formerly found for the quadrature of the circle, at a time when it was not known in *England* to have been invented before) has now been common for many years: For which reason he premises it at present, without any proof, only for the sake of some uses that have not hitherto been made of it.

Corollary 1. From this theorem for the tangent, the sine, suppose Y, and cosine Z of the multiple arch $n \times A$ may be readily found.

For,

For, if y be the sine, and z the cosine of the given arch A, then putting vv for $-yy$, and substituting $\frac{ry}{z}$ for t, and $\frac{rv}{z}$ for τ, and $\frac{rT}{\sqrt{rr+TT}}$ for Y.

The sine Y will be $\frac{\overline{z+v}|^n - \overline{z-v}|^n}{2r^n}$ p."

The cosine Z will be $\frac{\overline{z+v}|^n + \overline{z-v}|^n}{2r^{n-1}}$

Each of these may be differently exprest in a series, either by the sine and cosine conjointly, or by either of them separately.

Thus Y, the sine of the multiple arch $n \times A$, may be in either of these two forms, *viz.*

$$= \frac{z^{n-1}}{r^{n-1}} y \text{ in } n - \frac{n-1}{2} \cdot \frac{n-2}{3} \cdot {}'A \frac{y^2}{z^2} + \frac{n-3}{4} \cdot \frac{n-4}{5} \cdot {}'B \frac{y^4}{z^4} \text{ \&c. or } = ny - \frac{nn-1}{2.3rr}{}'Ay^3 - \frac{nn-9}{4.5rr}{}'By^5 - \frac{nn-25}{6.7rr}{}'Cy^7 - \text{\&c.}$$

Wherein the letters 'A 'B 'C, &c. stand, as usual, for the coefficients of the preceding terms.

The first of these theorems terminates, when n is any integer number, the other (which is Sir *Isaac Newton*'s rule, and is deriv'd from the former by substituting $\sqrt{rr-yy}$ for z) terminates when n is any odd number.

The cosine Z may, in like manner, be in either of these two forms, *viz.*

$$= \frac{z^n}{r^{n-1}} \text{ in } \frac{1-n}{1} \cdot \frac{n-1}{2} \cdot \frac{y^2}{z^2} + \frac{n}{1} \cdot \frac{n-1}{2} \cdot \frac{n-2}{3} \cdot \frac{n-3}{4} \cdot \frac{y^4}{z^4} - \text{\&c. or } = r - \frac{nn}{2rr}{}'Ay^3 - \frac{nn-4}{3.4rr}{}'By^4 - \frac{nn-16}{5.6rr}{}'Cy^6 - \text{\&c.}$$

The latter of which terminates when the number n is even, and the other as before, when it is any integer.

Corol 2. Hence the sine, cosine, and tangent of any submultiple part of an arch, suppose $\frac{1}{n} A$, may be determined thus;

The tangent of $\frac{1}{n}A$ will be $\dfrac{\overline{r+\tau}|^{\frac{1}{n}} - \overline{r-\tau}|^{\frac{1}{n}}}{\overline{r+\tau}|^{\frac{1}{n}} + \overline{r-\tau}|^{\frac{1}{n}}}\rho$.

The sine of $\frac{1}{n}$ A will be $\dfrac{\overline{z+v}|^{\frac{1}{n}} - \overline{z-v}|^{\frac{1}{n}}}{2r^{\frac{1}{n}}}\rho$.

For, these equations will arise from the transposition an[d] reduction of the former for the tangent and sine of the multipl[e] arch, upon the substitution of t, y, z, and A for T, Y, Z and $n \times A$.

Cor. 3. Hence regular polygons of any given number of side[s] may be inscrib'd within, or circumscrib'd without, a given arch of a circle: For, if the number n express the double of th[e] number of sides to be inscribed within, or circumscribed about the given arch A; then one of the inscrib'd sides will be th[e] double of the sine, and one of the circumscrib'd sides the double of the tangent of the submultiple part of the arch, *viz.* $\frac{1}{n}$A.

Lemma 2. To find the length of the arch of a circle within certain limits, by means of the tangent and sine of the arch.

Let t be the tangent, y the sine, and z the cosine of the arch A, whose length is to be determined; and let ρ, τ, v be expounded as before, then if any number n be taken, the arch of the circle will be always less than $\dfrac{\overline{r+\tau}|^{\frac{1}{n}} - \overline{r-\tau}|^{\frac{1}{n}}}{\overline{r+\tau}|^{\frac{1}{n}} + \overline{r-\tau}|^{\frac{1}{n}}} \times n\rho$.

and bigger than $\dfrac{\overline{z+v}|^{\frac{1}{n}} - \overline{z-v}|^{\frac{1}{n}}}{2r^{\frac{1}{n}}} \times n\rho$.

For, if, by the preceeding corollaries, a regular rectilinear polygon be inscrib'd within, and another without, the arch A, each having half as many sides, as is exprest by the number n; then will the former of these quantities be the length of the bow of the circumscrib'd polygon (or the sum of all its sides) which is always bigger; and the latter will be the length of the bow of the inscrib'd polygon, which is always less, than the arch of the circle, how great soever the number n be taken.

Cor. 1. Hence the series's for the rectification of the arch of a circle may be deriv'd.

For,

For, by converting the binominals into the form of a series, that the fictitious quantities, ρ, τ, v may be destroy'd; it will appear, that no number n can be taken so large as to make the inscribed polygon so big, or the circumscribed so little as the series $\frac{ry}{z} - \frac{ry^3}{3z^3} + \frac{ry^5}{5z^5} - \frac{ry^7}{7z^7} +$ &c. in one case; or its equal $t - \frac{t^3}{3r^2} + \frac{t^5}{5r^4} - \frac{t^7}{7r^6} +$ &c. in the other case.

Wherefore, since the quantity denoted by the sum of the terms in either of these series is always bigger than any inscrib'd polygon, and always less than any circumscribed, it must therefore be equal to the arch of the circle.

Cor. 2. If, in the first of the above series's, the root $\sqrt{rr-yy}$ be extracted and substituted for z, there will arise the other series of Sir *Isaac Newton*, for giving the arch from the sine; namely,

$$y + \frac{y^3}{6r^2} + \frac{3y^5}{40r^4} + \frac{5y^7}{112r^6} + \text{\&c. or otherwise}$$

$$= y + \frac{1}{1.2.3} \times \frac{y^3}{r^2} + \frac{3.3}{1.2.3.4.5} \times \frac{y^5}{r^4} + \frac{3.3.5.5}{1.2.3.4.5.6.7} \times \frac{y^7}{r^6} + \text{\&c.}$$

Scholium. In like manner, as the arches of the polygons serve to determine the arch of the circle; so by comparing the area's of the circumscrib'd and inscrib'd polygons, $\frac{1}{2}nrT$ and $\frac{1}{2}nYZ$, the area of the sector of a circle may be found; for if T, Y and Z are the tangent, sine, and cosine of the arch A; then by the second *Lemma*, the area of the circumscrib'd polygon will be found to be

$$\frac{1}{2}nr\rho \times \frac{\overline{r+\tau}|^{\frac{1}{n}} - \overline{r-\tau}|^{\frac{1}{n}}}{\overline{r+\tau}|^{\frac{1}{n}} + \overline{r-\tau}|^{\frac{1}{n}}} = \frac{1}{2}nrT.$$

And the area of the inscribed will appear to be

$$\frac{1}{2}n\rho \times \frac{\overline{z+v}|^{\frac{2}{n}} - \overline{z-v}|^{\frac{2}{n}}}{4r^{\frac{2}{n}-1}} = \frac{1}{2}nYZ.$$

But

But upon the expanſion of theſe binomials it will appea[r] that no number n can be taken ſo large, as to make the o[ne] ſo big, or the other ſo little, as the area denoted by the ſe-ries.

$$\tfrac{1}{2} r \text{ in } t - \frac{t^3}{3rr} + \frac{t^5}{5r^4} - \frac{t^7}{7r^6} + \&c.$$

So that this area being larger than any inſcribed, an[d] ſmaller than any circumſcribed polygon, muſt be equal to th[e] area of the ſector. It may be farther obſerv'd, that as th[e] arch or area is found from the ſine, coſine, or tangent of th[e] arch, by means of the limiting polygons; ſo may the ſin[e], coſine, or tangent be found from the length of the arch b[y] the ſame method.

Thus if A be the arch whoſe tangent T, ſine Y, and coſin[e] Z, are to be determin'd; then will the tangent

$$T \text{ be} = \frac{A - \frac{1}{1.2.3.} \times \frac{A^3}{r^2} + \frac{1}{1.2.3.4.5.} \times \frac{A^5}{r^4} - \&c.}{1. - \frac{1}{1.2.} \times \frac{A^2}{rr} + \frac{1}{1.2.3.4.} \times \frac{A^4}{r^4} - \&c.}$$

$$\text{Sine } Y = A - \frac{1}{1.2.3.} \times \frac{A^3}{r^2} + \frac{1}{1.2.3.4.5.} \times \frac{A^5}{r^4} - \&c.$$

$$\text{Coſine } Z = r - \frac{1}{1.2} \times \frac{A^2}{r} + \frac{1}{1.2.3.4.} \times \frac{r^3}{A^2} \times \frac{A^4}{r^3} \&c.$$

For, it may be made appear from the firſt *Lemma*, and it[s] corollaries, that if in any of theſe theorems, as ſuppoſe i[n] the 1ſt, the quantity A ſtand for the bow of the circumſcribed polygon, then will the quantity T, exhibited by the theorem be always bigger; but if for the bow of the inſcribed polygon always leſs than the tangent of the arch, how great ſoever th[e] number n be taken; and conſequently if A ſtands for th[e] length of the arch itſelf, the quantity T muſt be equal t[o] the tangent; and the like may be ſhewn for the ſine, and *mutatis mutandis*, for the coſine.

Theſe principles, from whence Mr. *Machin* has here de-rived the quadrature of the circle, which is wanted in the ſolution of the problem in hand, happen to be upon another account abſolutely requiſite for the reduction of it to a ma-nageable equation. But he has enlarged (more than was ne-ceſſary to the problem itſelf) on the uſes of this ſort of qua-drature by the limiting polygons; becauſe it is one of that kind which requires no other knowledge but what depend[s]

o[n]

the common properties of number and magnitude: And may ſerve as an inſtance to ſhew that no other is requiſite r the eſtabliſhment of principles for arithmetic and geo- etry; a truth which tho' certain in itſelf, may perhaps em doubtful from the nature and tendency of the preſent quiries in mathematicks: For, among the moderns ſome ve thought it neceſſary for the inveſtigation of the relations f quantities, to have recourſe to very hard hypotheſes, ſuch s that of number infinite and indeterminate; and that of agnitudes, exiſting in *ſtatu fieri*, in a potential manner, which e actually of no bigneſs. And others, whoſe names are truly o be reverenced on account of their great and ſingular inven- ons, have thought it requiſite to have recourſe even to prin- iples foreign to mathematicks, and have introduced the conſi- eration of efficient cauſes and phyſical powers for the produc- on of mathematical quantities, and have ſpoken of them, and ſed them, as if they were a ſpecies of quantities by themſelves.

N. B. In the following propoſition, Mr. *Machin* has, for revity ſake, made uſe of a peculiar notion for compoſite mbers, (or ſuch quantities as are analogous to them) whoſe ctors are in arithmetical progreſſion.

The quantity expreſs'd by this notation has a double dex; that at the head of the root at the right hand, but parated by a hook to diſtinguiſh it from the common in- ex, denotes the number of factors; and that above, within e hook on the left hand, denotes the common difference f the factors, proceeding in a decreaſing or increaſing arith- etical progreſſion.

Thus the quantity $\overline{n+a}|^{\overset{a}{\smile}m}$ denotes by its index m on e right hand that it is a compoſite quantity, conſiſting of o many factors, as there are units in the number m: and the dex a above on the left hand denotes the common difference f the factors, decreaſing in an arithmetical progreſſion, if be poſitive; or increaſing, if it be negative: And ſo ſigni- es, in the common notion at the compoſite number or uantity $\overline{n+a}\,\overline{n+a-a}.\,\overline{n+a-2a}$, and ſo on.

For example $\overline{n+5}|^{\overset{2}{\smile}6}$ is $=\overline{n+5}.\,\overline{n+3}.\,\overline{n+1}.\,\overline{n-1}.\,\overline{n-3}\,\overline{n-5}$. conſiſting of ſix factors, whoſe common ifference is 2. After the ſame manner $\overline{n+4}|^{\overset{2}{\smile}5}$ is $=\overline{n+4}.\,\overline{n+2}.\,n.\,\overline{n-2}.\,\overline{n-4}$ conſiſting of five factors. Ac-

According to which method it will easily appear, that i[f] be any integer, then $\underset{n+2a+1}{\overline{\quad\overset{2}{\smile}}}(2a+2$ will be $= nn -$ $\overline{nn-9}.\ \overline{nn-25}$, continued to such a number of dou[ble] factors, as are exprest by $a+1$, or half the index, which [in] this case is an even number: So $\underset{n+2a}{\overline{\quad\overset{2}{\smile}}}(2a+1$ will be equ[al] to $n.\ \overline{nn-4}.\ \overline{nn-16}.\ \overline{nn-36}$, and so on, where th[ere] are to be so many double factors, as with one single facto[r] will make up the index $2a+1$, which is an odd number.

If the common difference a be an unit, it is omitted:

Thus $\breve{n}(^6$ is $= n.\ \overline{n-1}.\ \overline{n-2}.\ \overline{n-3}.\ \overline{n-4}.\ \overline{n-}$ containing six factors.

So $6(^6$ is $= 6.\ 5.\ 4.\ 3.\ 2.\ 1$; and the like for others.

If the common difference a be nothing, then the hook [is] omitted; and it becomes the same with the geometrical pow[er].

So $\underset{n+a}{\overline{\quad\overset{0}{\smile}}}(^m$ is $= \overline{n+a}|^m$, according to the common no[ta]tion

Proposition 1. An arch less than a semicircle being give[n] together with a point in the diameter passing thro' one of its e[x]tremities; to find, by means of the sine of a given part of t[he] arch less than one half, the area of the sector subtended by t[he] given arch, and comprehended in the angle, made at the giv[en] point.

Let P N A (Fig. 11. Plate XI.) be a semicircle described [about] the centre C, and diameter A P; and let P N be the given arc[h] less than a semicircle, and S the given point in the diamet[er] A P passing thro' one of the extremities of the arch N P in [P]. Then taking any number n bigger than 2, let P K be an ar[ch] in proportion to the given arch P N, as unity to the number [n]; and let it be required to find, by means of the sine of the ar[ch] P K, the area of the sector N S P, subtended by the given ar[ch] N P, and comprehended in the angle N S P, made at t[he] given point S.

From N and K let fall on the diameter A P the perpendic[u]lars N M and K L, and join C N and C K.

Then let r stand for C P the semidiameter of the circle; [c] for C S the distance of the given point S from the centre; [d] for S P the distance of it from the extremity of the arch thr[o'] which the diameter A P passes; and y for K L the sine of th[e] arch K P in the given circle.

The[n]

These substitutions being presupposed, the problem is to be divided into two cases; one when S P is less, and the other, when it is greater than the semidiameter C P.

Case 1. If S P be less than C P, then take an area H equal to the sum of the rectangles, exprest by the several terms of the following series, continued at pleasure,

$$\frac{py}{1} + \frac{t + \overline{n + \overset{\overset{2}{\smile}}{1}}|^{2} \times f}{\underset{\smile}{3}|^{3}} \times \frac{y^3}{t^2} + \frac{9t - \overline{n + \overset{\overset{2}{\smile}}{3}}\overset{\overset{4}{\smile}}{\times} f}{\underset{\smile}{5}|^{5}} \times \frac{y^5}{t^4}$$

$$+ \frac{9 \times 25 t + \overline{n + 3}\overset{\overset{2}{\smile}}{|}^{6} \times f}{\underset{\smile}{7}|^{7}} \times \frac{y^7}{t^6} + \text{\&c.}$$

And the area $\frac{1}{2} n \times$ H will determine the area of the sector NSP at pleasure.

For, the sector PSN, being the excess of the sector NCP above the triangle NCS, will be the difference of two rectangles $\frac{1}{2}$ CP × PN — $\frac{1}{2}$ CS × NM; but PN is the multiple of the arch PK; namely n × PK; and NM is the sine of that multiple arch; wherefore if for CP be put t, for CS, f, according to the supposition; and if for PK be substituted

$$\frac{y}{1} + \frac{1}{\underset{\smile}{3}|^{3}} \times \frac{y^3}{t^2} + \frac{9}{\underset{\smile}{5}|^{5}} \times \frac{y^5}{t^4} + \frac{9 \times 25}{7|^{7}} \times \frac{y^7}{t^6} + \text{\&c. by}$$

Cor. 2. *Lem*. 2. and for N M.

$$\frac{ny}{1} - \frac{n . \overline{n + \overset{\overset{2}{\smile}}{1}}|^{2}}{\underset{\smile}{3}|^{3}} \times \frac{y^3}{t^2} + \frac{n . \overline{n + \overset{\overset{2}{\smile}}{3}}|^{4}}{\underset{\smile}{5}|^{5}} \times \frac{y^5}{t^4} - \frac{n . \overline{n + \overset{\overset{2}{\smile}}{5}}|^{6}}{\underset{\smile}{7}|^{7}} \times \frac{y^7}{t^6} +$$

&c. according to *Cor*. 1. *Lem*. 1. the area of the sector will appear in a series, as is above determin'd.

But since the number n is greater than 2, and the given arch PN is less than a semicircle; and consequently, KL or y, the sine of the submultiple arch PK is less than the semidiameter CP or t; it may thence be easily prov'd, that the series will approximate to the just quantity of the area, at pleasure.

Cor. 1. Hence if the number n be taken equal to $\sqrt{5+\sqrt{25+\frac{9p}{f}}}$, the sector NSP will be

$$=\tfrac{1}{2}npy+\frac{n^3 t-n.\overline{n.n-1}.p}{12tt}y^3+****+\frac{n^3}{1120t^5}y^7+$$

&c.

For, the numerator of the coefficient of the third term in the series, that determines the area H, namely $\overline{9t-n+3|}^2$

is equal to $9t-\overline{nn-1}.\overline{nn-9}.f$; which according to the above determination of the number n, will become nothing. Wherefore, if for $t-p$ be put f in the second term, and the value of n be substituted for n in the third and fourth, the series for the area will appear upon reduction to be as is here laid down.

Cor. 2. Hence the area of the sector NSP may be always defined nearly by the terms of a cubic equation.

For, the number n, as constructed in the former *Corollary*, is always greater than the square root of 10; and consequently $\frac{y}{t}$ is always less than the sine of one third part of the given arch: So that the fourth term $\frac{n^3}{1120t^5}y^7$, with the sum of all the following terms of the series, can never be more than a small part of the whole sector.

Cor. 3. If R stand for 57,2957795, &c. degrees (or the number of degrees contain'd in an angle subtended by an arch of the same length with the radius of the circle) and M be the number of degrees in an angle, which is to 4 right angles, as the area NSP to the area of the whole circle; then will M

$$=\frac{np}{t}\times\frac{Ry}{t}+\frac{n^3t-n.\overline{nn-1}.}{6t}p\times\frac{Ry^3}{t^3}\text{ nearly.}$$

For, $\frac{M}{R}\times\frac{tt}{2}$ will appear by the construction to be equal to the sector NSP.

Case 2. If SP be greater than CP, then take an area H, equal to the sum of the terms in the following series.

Series

$$\frac{py}{1} + \frac{\overline{t - n + 1}|^{2} \times f}{\underbrace{3}_{}|^{3}} \times \frac{y^3}{t^2} + 9\,\frac{\overline{t + n + 3}|^{4} \times f}{5|^{5}} \times \frac{y^5}{t^4} +$$

$$\frac{9 \times 25\, \overline{t - n + 5}|^{6} \times f}{7|^{7}} \times \frac{y^7}{t^6} +, \text{\&c.}$$ and the area $\frac{1}{2}\, n \times$ H will be the sector, as before.

For, the point S being on the contrary side of the centre to what it was before, it will easily appear, that the change of $+f$ into $-f$ must reduce one case to the other, without any other proof.

Cor. Hence if the number n be taken equal to $\frac{\sqrt{t+f}}{f}$; or in this case $\frac{\sqrt{p}}{f}$, then the series for the sector will want the second term, as in the former it wanted the third.

Definition. The angle, called by *Kepler* the *anomalia eccentri*, is a fictitious angle in the elliptic orbit of a planet, being analogous to the area described by a line from the centre of the orbit, and revolving with the planet from the line of *apsides*; in like manner as the mean anomaly is a fictitious angle, analogous to the area, described by a line from the focus.

Otherwise, if C be the centre, S the focus of an elliptic orbit, described on the transverse axis A P, and the area N S P in the circle be taken in proportion to the whole, as the area described in the ellipsis about the focus, to the whole; then is the arch of the circle P N, or the angle N C P, that which *Kepler* calls the *anomalia eccentri*.

This angle may be measured either from the aphelion, or perihelion; in the following proposition it is supposed to be taken from the perihelion.

Prop. 2. The mean anomaly of a comet or planet, revolving in a given elliptic orbit being given, to find the *anomalia eccentri*.

The solution of this problem requires two different rules, the first and principal one serves to make a beginning for a farther approximation, and the other is for the progression in approximating nearer and neaerr *ad libitum*.

1. The

1. The rule for the first assumption. Let t, f, p, stand as before, for the semi-transverse axis of the ellipsis, the semi-distance of the foci, and the *perihelion* distance; then taking the number n equal to $\sqrt{5+\sqrt{59+\frac{9p}{f}}}$; let T stand for $\frac{2t}{nnt-nn-1.p}$; and P for $\frac{2p}{nnt-nn-1.p}$. (or $\frac{p}{t}$ T) which constant number, being once computed for the given orbit, will serve to find the angle required nearly by the following rule.

Let M be the number of degrees in the angle of mean anomaly to the given time, reckon'd from or to the perihelion; and supposing R, as before, to stand for 57, 2957, &c. degrees; take the number $N=\sqrt[3]{\frac{3T}{nR}}M$, and let A be the angle whose sine is

$$N\sqrt[3]{\tfrac{1}{2}+\sqrt{\tfrac{1}{4}+\frac{P^3}{N^6}}}+N\sqrt[3]{\tfrac{1}{2}-\sqrt{\tfrac{1}{4}+\frac{P^3}{N^6}}}$$

Then the multiple angle $n\times A$ will be nearly equal to the *anomalia eccentri*.

The truth of which will appear from the resolution of the cubic equation in the last corollary to the preceeding proposition.

Cor. 1. If the quadruple of the quantity $\frac{P^3}{N^6}$ be many times greater, or many times less than unity; or which amounts to the same thing, if the mean anomaly *M* be many times less, or many times greater, than the angle denoted by the given quantity $\frac{2}{3}\frac{np}{t}R\sqrt{P}$ (the one or the other of which two cases most frequently happens in orbits of very large eccentricity) then the theorem will be reduced to a simpler form near enough for use.

Case 1. If M be many times less than $\frac{2}{3}\frac{np}{t}R\sqrt{P}$ then the angle A may be taken for that whose sine is $\frac{t\times M}{np\times R}$.

Case 2. If M be many times greater than $\frac{2}{3}\frac{np}{t}R\sqrt{P}$; then

then let A be the angle whose ſine is $N - \frac{P}{N}$, and the multiple angle $n \times A$, according to its caſe, will be nearly equal to the angle required.

Cor. 2. In orbits of very large eccentricity, the perihelian diſtance p is many times leſs than the ſemi-diſtance of the foci f, and the number $n = \sqrt{5 + \sqrt{25 + 9\frac{p}{f}}}$, is always nearly equal to $\sqrt{10}$, or the integer 3, either of which may be uſed for it without any material error in the orbits of comets.

II. The Rule for a farther correction *ad libitum.*

Let M be the given mean anomaly, t the ſemi-tranſverſe axis as before; and let B be equal to, or nearly equal to the multiple angle n A before found, then if μ be the mean anomaly, and x the planet's diſtance from the ſun, computed to the *anomalia eccentri* B; the angle $\grave{B}$ taken equal to $B + \frac{t}{x} \times \overline{M - \mu}$ will approach nearer to the true value of the angle ſought; and by repeating the ſame operation, the approximation may be carried on nearer and nearer *ad libitum.*

This laſt rule being obvious, the explication of it may be omitted.

Scholium. In this ſolution, where the motion is reckon'd from the perihelion, the rule is univerſal, and under no limitation: But had the motion been taken from the aphelion, the problem muſt have been divided into two caſes; one is, when the eccentricity is leſs than $\frac{9}{16}$; the other is when it is not leſs, but is either equal to, or more than in that ratio.

If the eccentricity be not leſs than $\frac{9}{16}$, then the ſame rule will hold as before, only putting the aphelian diſtance, ſuppoſe a, inſtead of the perihelian diſtance p, and ſubſtituting $-f$ for $+f$ in the rule for the number n.

If the eccentricity be leſs than $\frac{9}{16}$, then take the number n equal to $\sqrt{\frac{a}{f}}$ and $\frac{t}{na} \times \frac{M}{R}$ will be nearly equal to the ſine of the ſub-multiple part of the *anomalia eccentri*, denominated by the number n, as before.

It is needleſs to obſerve, that the like rules would obtain in hyperbolic orbits, *mutatis mutandis.* But that which perhaps

ſort

may not appear unworthy of being remark'd, concerning this sort of solution from the cubic root, is, that tho' the rule be altogether impossible upon a total change of the figure of the orbit either into a circle, or into a parabola; yet it will operate so much better, aad stand in need of less correction, according as the figure advances nearer in its change towards either of these two forms.

That the use of the method may the better appear, Mr. *Machin* adds a few examples; two for the orbits of planets, one the most, and the other the least eccentric; but which are more to shew the extent of the rule, than to recommend the use of it in such cases: For, there are many other much better and more expeditious methods in orbits of small eccentricity: The other two examples are adapted to the orbits of two comets, whose periods have been already discover'd by Dr. *Halley*; the one is to shew the use of one of the rules in the first corollary, and the other is to explain the use of the other rule.

Ex. 1. For the orbit of *Mercury*.

If an unit be put for the semi-transverse axis, t, the eccentricity 0, 20589 will become f, and the perihelian distance p will be 0, 79411; wherefore by means of the number R, given as before, the constant numbers for this orbit will appear to be

$$n = 3,56755,\quad T = 0,5857271,\quad P = \frac{p}{t}T = 0,4651319;$$ and

hence $\frac{3T}{n \times R} = 0,0085965$.

Suppose M the mean anomaly from the perihelion to be 120°, to which it is requir'd to find the *anomalia eccentri*.

Here since the mean anomaly M is not many times more than the limiting angle $\frac{2np}{3t} R \sqrt{P}$ (which in this orbit is about 74 degrees) recourse must be had to the general rule in the proposition.

The number N then, which is $\sqrt[3]{\frac{3T}{nR}M}$ will be $= 1,0104195$, which found gives

$$N\sqrt[3]{\tfrac{1}{2} + \sqrt{\tfrac{1}{4} + \frac{P^3}{N^6}}} = 1,0389090,$$ and also

$$N\sqrt[3]{\tfrac{1}{2} - \sqrt{\tfrac{1}{4} + \frac{P^3}{N^6}}} = 0,4477126:$$ Wherefore the sum of both (under their proper signs) *viz.* 0, 5911964 will be the sine, whose

whose arch $36°, 24195$ is the angle A, the multiple whereof $n \times A = 129°, 295503$ will be the angle to be first assumed for the *anomalia eccentri*.

For a farther correction; this angle, now call'd B, whose sine is (suppose) y, and its cosine z, gives, by a known rule, $t + \frac{f}{t}z = 1, 1304$ for x the planet's distance from the sun; and by another known rule $B - \frac{fR}{tt}y = 120°, 16568$ for μ the mean anomaly to the *anomalia eccentri* B: Wherefore, the correct angle $B = B \times \frac{t}{x} \times \overline{M - \mu}$ will be $129°, 14846 = 129°. 8'. 54'', 5$, erring, as will appear from a farther correction, about a tenth of a second.

This angle, being thus determined, will, by the common methods, give $137° 48' 33''$ and $\frac{1}{2}$ for the true anomaly or angle at the sun; the sine of the true anomaly being in proportion to the sine of the *anomalia eccentri*, as the semi-conjugate axis to the planet's distance from the sun. So that the equation of the centre in this example is $17° 48' 33''$ and $\frac{1}{2}$.

Ex. 2. for the orbit of *Venus*.

Supposing, as before, the mean distance t to be unity, and the eccentricity f to be $0, 0069855$; the constant numbers for this orbit will be $p = 0, 9930115$, $n = 6, 4116$, $T = 1,562134$, $P = 0, 1551217$, $\frac{3T}{nR} = 0, 0127571$, and the limiting angle $\frac{2np}{3t} R \sqrt{P}$ will appear to be about 303 degrees.

Let M be 120°, as in the former example. Then, since the mean anomaly is, in this case, not many times less than the limiting angle, the general rule must be used as before; according to which the number N will appear to be $1, 152585$, the sine of A will be $0. 3217917$, the angle A $18, 077132$, and the multiple $n \times A$ or angle B, for the first assumption of the *anomalia eccentri* will be $120°, 35416$.

This angle B will give, by the method before explained, the angle $B = 120°, 34555$, or $120° 21' 44''$ *fere*, for the *anomalia eccentri* correct; the error of which will, upon examination, appear to be but a small part of a second.

In this example the true anomaly is $120° 41' 25'', 1$; and consequently, the equation of the centre no more than $41' 25'', 1$.

Ex.

Ex. 3. For the orbit of the comet of 1682.

To know the mean anomaly of this comet to any given time, it is to be premised, that it was at the perihelion *An.* 1682, on the 4th of *September* at 21 ho. 22 min. equated time to the meridian of *Greenwich*, and performs its revolution round the sun, as Dr. *Halley* has discover'd, in 75 years and a half.

The perihelian distance p is, according to his determination, 0, 0326085 parts of the mean distance t: So that the constant numbers for the orbit will be $n = 3,\ 1676061$, $T = 0,\ 2054272$ $P = 0,\ 00669867$, and the limiting angle $\frac{2np}{3t} R \surd P$ will be about 19 minutes or $\frac{1}{3}$ of a degree.

In the orbits of comets, the rule for the first assumption of the *anomalia eccentri* is generally sufficient without correction.

Thus, suppose the mean anomaly M to be 0, 072706 (as it was at the time of an observation made at *Greenwich* on the 30th of *August*, 1682, at $7^h\ 42'$ equat. time) then the general rule (which must be here us'd, since the angle of mean anomaly is not above four or five times less than the limiting angle) will give $n \times A$ or $B = 2^\circ\ 12'\ 48''$, 7, erring about $\frac{7}{12}$ of a second from the true *anomalia eccentri*.

But in these orbits the rules in the first corollary to the second proposition most frequently take place, especially the last; and the calculation may also be farther abreviated, by putting the square root of 10, or the integer 3, for the number n.

Suppose the mean anomaly to be 0°, 006522, or 23 ,4792, here, since M is 50 times less than the limiting angle, the rule in the first case of the first corollary may be us'd; that is, to take the sine of the angle $A = \frac{t \times M}{np \times R}$.

Wherefore, if the number 3 be put for n, the sine of A, which is $\frac{tM}{3pR}$ will be $= 0,\ 00116367$; and consequently, the angle A will be $4'\ 0''$, 011; and the multiple angle $n \times A$ to be assumed for the *anomalia eccentri* will be $12'.\ 0''$ '033; the error of which will be found to be about $\frac{1}{30}$ of a second.

Ex. 4. For the orbit of the great comet *An.* 1680.

This comet, according to Dr. *Halley*, performs its period in 575 years; and was in its perihelion on the 7th of *December* 1680, at $23^h\ 9'$ equat. time at *London*, the perihelian distance p is 0, 000089301, in parts of the mean distance t: Wherefore, supposing the number n to be $\surd 10$, the constant numbers for the orbit will be $T = 0,\ 2000161$, $P = 0,\ 000017862$, and the limiting

limiting angle $\frac{2npRrP}{3t}$ will be about $\frac{1}{6}$ of a second.

Suppose the mean anomaly to be 3′ 31″, 4478, or 0°,0587354I (as it was at the time of the first observation of it in *Saxony*, *Nov.* 3. at 16h 47′ equat. time at *London*) here since the mean anomaly is many times greater than $\frac{1}{6}$ of a second, the rule in the second case of the first corollary may be used; that is, by taking the sine of $A = N - \frac{P}{N}$.

But the number N or $\sqrt[3]{\frac{3T}{nR}}M$ is $=$ 0, 05794134, and $\frac{P}{N}$ will be equal 0, 0030827; wherefore $(N - \frac{P}{N} =$ 0, 05763307 will be the sine, whose arch 3°, 30397 is the angle A; and the multiple angle $n \times A =$ 10° 26′ 53″, 05 will be the angle to be first assumed for the *anomalia eccentri*; the error of which will be found to be less than a second.

The true anomaly, computed from this angle, according to the rule in the example for *Mercury*, will appear to be 171° 38′ 24″ from the perihelion.

By these examples it appears, that the solution is universal in all respects: For, the two first, compared with the two last, serve to shew that it is not confined to any particular parts of the orbit, but extends to all degrees of mean anomaly: And by comparing the second with the last, it sufficiently appears to be universal with respect to the several degrees of eccentricity; since in one, the equation of the centre for the reduction of the mean to the true motion is not so much as the $\frac{1}{170}$ part of the whole; whereas in the other it amounts to almost 3000 times as much as the mean motion itself.

Upon reviewing the reflections on the quadrature of the circle, Mr. *Machin* thinks it necessary, in order to prevent any mistake, that may arise from the different opinions, that obtain about the nature of mathematical quantity, to explain himself a little upon that head; as also to add a few words to shew, how the method of quadrature by limiting polygons takes place in other figures as well as the circle.

Mr. *Machin* takes then a mathematical quantity, and that for which any symbol is put, to be nothing other than number, with regard to some measure, which is considered as one: For, we cannot know precisely and determinately, that is, mathemati-

cally, how much any thing is, but by means of number. Th
notion of continued quantity, without regard to any measure,
indistinct and confused; and tho' some species of such quantity
considered physically, may be described by motion, as lines b
points, and surfaces by lines, and so on; yet the magnitudes o
mathematical quantities are not made by that motion, but b
numbering according to a measure.

Accordingly, all the several notations, that are found necessar
to express the formations of quantities, do refer to some office o
property of number or measure; but none can be interpreted t
signify continued quantity as such.

Thus some notations are found requisite to express number i
its ordinal capacity, or the *numerus numerans*, as when on
follows or preceeds another, in the first, second, or third, plac

from that, upon which it depends; as the quantities $\grave{x}, \grave{\grave{x}}, x, \acute{x}, \acute{\acute{x}}$
referring to the principal one x.

So, in many cases, a notation is found necessary to be given t
a measure as a measure; as for instance, Sir *Isaac Newton's*
symbol for a fluxion $\dot{x}$: For, this stands for a measure of some
kind, and accordingly he usually puts an unit for it, if it be the
principal one upon which the rest depend.

So some notations are expresly to shew a number in the
form of its composition, as the index to the geometrical power
x^n, denoting the number of equal factors, which go to the com-
position of it, or what is analogous to such.

But that there is no symbol or notation but what refers to dis-
crete quantity, is manifest from the operations, which are all
arithmetical.

And hence it is, there are so many species of mathematical
quantity, as there are forms of composite numbers, or ways in
the composition of them; among which there are two more
eminent for their simplicity and universality than the rest: One
is the geometrical power, formed from a constant root; and the
other, tho' well known, yet wanting a name, as well as a nota-
tion, may be call'd the arithmetical power, or the power of a
root uniformly increasing or diminishing, and is that whose no-
tation is design'd above, after *Scholium Lemma* 2: The one is
only for the form of the quantity itself, the other is for the con-
stitution of it from its elements.

Now from the properties of either of these it would be easy
to shew, how the quadratures of simple figures are deducible
from the area's of their limiting polygons. Mr. *Machin* just
points out the method from the arithmetical power, as being
the shortest and readiest at hand.

Let

Let $z, \acute{z}, \acute{\acute{z}}$, &c. or $z, \grave{z}, \grave{\grave{z}}$, &c. be quantities in arithmetical progreſſion, diminiſhing or increaſing by the common difference $\dot{z}$; and let (as has been before explain'd) $\overset{\dot{z}}{\underset{z}{\smile}}(m$ ſignify the arithmetical power of z, denominated by the potential index m, namely $z \times \acute{z} \times \acute{\acute{z}}$, &c. whoſe firſt root is z and laſt $z - \overline{m-1} \times \dot{z}$, which being ſuppoſed, the element of the arithmetical power will be $m\dot{z} \times \overset{\dot{z}}{\underset{z}{\smile}}(m-1$, that is, the product made from the multiplication of the two indices, and the next inferior power of the next root in order: For, the firſt arithmetical power $\overset{\dot{z}}{\underset{z}{\smile}}(m$ is $= z \cdot \overset{\ddot{z}}{\underset{\acute{z}}{\smile}}(m-1$, and the next $\overset{\dot{z}}{\underset{\acute{z}}{\smile}}(m$ is $= \overset{\dot{z}}{\underset{\acute{z}}{\smile}}(m-1 \times \overline{z - m\dot{z}}$; wherefore the difference will be as is explain'd.

And conſequently, ſince the ſum of theſe elements or differences, taken in order from the firſt to the laſt, do make up the quantity, according to its *termini*; hence, if z be the abſciſs of a curvilinear figure, whoſe ordinate y is equal to $m z^{m-1}$, a demonſtration might eaſily be made, that the form of the quantity for the area will be z^m; that is, the ſame multiple of the next ſuperior power of z, divided by the index of that power.

For, ſince the arithmetical powers do both unite and become the ſame with the geometrical power, when the differential index $\dot{z}$ is ſuppoſed to be nothing; the magnitude of the geometrical figure will be implied from the magnitudes of the two polygons, made up of rectangles, one from the increaſing, the other from the diminiſhing arithmetical power; tho' it be true, that the elements of the polygons cannot be ſumm'd up, when $\dot{z}$, the meaſure of the abſciſs z, is ſuppoſed to be nothing.

In like manner, in any other caſe where z and $\acute{z}$ are two abſciſſes whoſe difference as a meaſure is $\dot{z}$, and $y, \acute{y}$ the two ordinates; the magnitude of the figure will be implied by the magnitudes of the two polygons, which are made from the ſum of the inſcribing and circumſcribing elements $\dot{z}y$ and $\dot{z}\acute{y}$;

tho' the figure itself is not to be resolved into any such primi-genial rectangular elements.

And thus, Mr. *Machin* thinks, that the symbol $\dot{z}$, consider'd as a component part of the rectangle $z\,y$, may bear a plain interpretation; *viz.* that it is the measure, according to which the quantity z is measur'd; nor can he see that any other interpretation need be put upon a symbol, which, like a measure, is used only to make other things known, but is of itself nothing but a mark.

And what is said of the elements of the first resolution, is easily applicable to those of a second or third, and so on: The last may always be consider'd as the measure of the former, and is indivisible; tho' in respect of the following, it be taken as the part, according to which the measure was made, and therefore be divisible.

A Description of a new invented Water-bellows; *by* M. Triewald. Phil. Trans. N° 448. p. 231.

THE water-bellows M. *Triewald* here proposes are, as to their effect, noways inferior to the wooden bellows, made use of in *Sweden* at all their iron forges, and furnaces, *&c.* but far more advantageous in all other smelting works, that require large bellows.

Whoever has seen the invention, described in the *Philosophical Transactions*, and made use of at *Tivoli* in *Italy*, and several other places, and call'd *soffi d'acqua*; and attentively considers the following description, will be convinced, that this new invention of water-bellows is built on the very same foundation, to which leathern and wooden bellows owe their use and original, and in several cases prove of more signal service.

The water-bellows A and A (as represented in the Fig. Plate XII.) are made of wood, not unlike the shape of diving bells, in the form of a truncated cone, and consequently wider below than at top, where they are furnish'd with close heads B and B, but at the lower ends E and E quite open. At the heads B and B are two valves V and V, which open internally, and are made like the claps of other bellows, with their hinges, and the valves themselves cover'd with hatters felt, and shut by an easy steel spring, till the air from above opens the same, which happens only when these bellows receive their motion upwards; but are shut by means of the pressure of the air within, when they

they sink down into the water. On the very same heads are two pliable leathern tubes R and R, fixt one at the top of each water-bellows, which tubes are made and prepared in the same manner as those used in water-engines for extinguishing fire: These leathern tubes or pipes reach from the bellows to wooden tubes, T, T, which carry the wind into the iron furnace M, or any other place, according to pleasure.

These bellows are likewise provided with iron chains *k*, K, which are fastened to two sweeps, S, S, by which means they hang perpendicular from the beam of the balance, and at the same distance from the centre of its motion C.

On the balance are two sloping gutters, F, F, into which the water alternately runs from the gutter G, and so gives motion to the whole work; So that these last mentioned gutters do the same service as an over-shot, or any other water-wheel, and cost a great deal less, but give as even and regular a motion, as any pendulum for measuring of time: For, as soon as so much water runs into either of the afore-mentioned inclined planes of the gutters, so that the momentum of the water exceeds the friction near the centre of motion C, the gutter immediately moves down, with a velocity increasing, till the balance meets with the resistance of the wooden springs H and H, and at the same time raises the opposite water-bellows, or that bellows which is fixt under the opposite gutter. In the same moment again, as the said gutter begins its motion, being come down on the spring, delivers all the water it has receiv'd; and the very same time the water begins to run into the opposite gutter, which receives its load of water almost as soon as the former is emptied: So that one of the gutters does its effect, as soon as the other has done its effect; and this alternately one after another.

These sloping gutters on the balance do, therefore, all the service and effect, which a water-wheel does in working the ordinary bellows, and that by means of the power which the water applies to the wheel for giving the common bellows their motion; after the same manner does the water here enable the sloping gutters to do the same work.

But as to the manner and the means whereby these water-bellows are fit to blow the fire, and perform the same as leathern and wooden ones, there is no other reason but the very self-same wherein the effect of the ordinary bellows consists: For, an ordinary pair of bellows blow for no other reason, but that the

the air which enters the bellows, and which they contain whe[n] rais'd, is again compreſs'd or forced into a narrower ſpac[e] when the bellows cloſe: Now ſince the air, like all other fluid[s] moves to that place where it meets with the leaſt reſiſtence, [it] muſt conſequently go thro' the opening left for it, with a velo[-] city proportioned to the force by which the air is compreſs'd and muſt neceſſarily blow ſtronger or weaker, in proportion t[o] the velocity by which the top and bottom of the bellows meet the blaſt will alſo laſt in proportion to the quantity of air, tha[t] was drawn into the bellows thro' the valve or wind clap.

This happens in the ſame manner in water-bellows: For, th[e] air which they contain cannot force itſelf down through th[e] water more than thro' a well ſecured deal board with pitch when the bellows are lower'd down into the water, the air which they contain muſt neceſſarily be compreſs'd by the water which riſes alternately into the bellows A and A: So that the air muſt recede and go thro' the leathern tubes R, R, where the air meets with the leaſt reſiſtance.

From all which it undoubtedly follows, that the larger, that is to ſay, the more air theſe water-bellows are made to contain, and the greater the velocity is by which they are made to deſ-cend into the water, ſo much the greater is their effect; and that the effect, which they are able to perform, muſt be equal to that of leathern or wooden bellows of the ſame capacity, in contain-ing an equal quantity of air.

As to the advantages which this new invention has in regard to theſe hitherto made uſe of, it is a thing known, that the power which works the common bellows, made uſe of at iron furnaces, muſt be ſufficient not only to compreſs the bellows, but at the ſame time to force down the leaver with its weight or counterpoiſe; which leaver ſerves again to raiſe the bellows, when the cog or button on the axle-tree of the water wheel ſlides off from the bellows-tree: So that the power muſt be ſufficient at once to produce two different effects; whereas theſe new water-bellows require ſcarce any greater power than what is neceſſary to overcome the friction near the centre of motion, or the axis C: For, in this invention of M. *Triewald*'s an advantage is obtain'd, which very rarely happens in mechanics, *viz.* that the weight to be mov'd is, as here, on the balance in *æquilibrio*; ſince the bellows A and A cannot be otherwiſe conceiv'd than as two equal, tho' heavy, weights in a pair of ſcales, which balance each other, tho' their weight be ever ſo great: So that if each of

of these bellows should weigh a ton, they must still equiponderate; which is so much the easier attain'd to, since it requires very little art to make them both of a weight, and order them at equal distances from the centre of motion.

It is, consequently, known how small a power is required to set the scales of a balance with equal weights in motion; notwithstanding the weight may be as great as possible: All which may with good reason be applied to these water-bellows.

And tho' it cannot be denied, but that the bellows which sinks down into the water-hole or sump N, becomes so much lighter, as it loses of its weight in water, by which means the water-bellows to be rais'd becomes so much heavier, as the former loses of its weight by being let down into the water; yet this is compensated, if we consider that the water which falls down along the sloping gutter, acquires a power of a falling body; which power increasing in the same proportion as the bellows to be rais'd grows heavier, this power suits admirably well the weight to be rais'd: For, the bellows that sinks down into the sump N, does not at once lose its weight in the water, but gradually as it comes deeper into the same: And in the same manner the ascending bellows does not grow at once heavier than the other, but gradually, growing heaviest just when the lowermost edge gets even with the surface of the water; and that happens at the same instant of time when the power of the water in the sloping gutter is at the highest pitch, or has receiv'd its greatest *momentum*.

This shews very plainly, that the power requir'd to work these water-bellows is far less; and consequently, less water will be consumed in working these bellows than those commonly used: And again, that an iron furnace, which for want of water to work the common bellows, cannot be kept at work longer than six weeks, tho' it be provided with all necessaries, may by means of such water-bellows as here described, be kept at work at least as long again.

It is furthermore a thing known to miners, of what prodigious loss and inconveniency it is, when the hearth or mouth of an iron furnace is placed low, in a wet and damp place, which they are oftentimes obliged to do, in regard to the axle-tree of the water wheel, which works the bellows; for which reason such furnaces as stand in the like moist

places

places give daily conſiderably leſs iron than others which ar[e] better ſituated.

There is likewiſe no ſmall difficulty to find a fit ſituatio[n] for ſuch iron furnaces where iron guns are caſt, and re-quire deep pits under the mouth of the furnace: But b[y] means of this new invention of bellows, one may be at li-berty to place the mouth of the furnace as high as on[e] pleaſes, ſeeing it is very eaſy to guide the blaſt by means o[f] wooden or leaden tubes, as far as neceſſary, and in a prope[r] direction into the furnace; which advantage cannot ſo eaſil[y] be obtain'd by thoſe bellows in common uſe.

Further, this may be accounted as no ſmall advantag[e] which theſe bellows afford, in being of ſo very eaſy a ſtruc-ture, that any carpenter at firſt ſight is able not only to con-ſtruct the whole engine, but eaſily repair every part of th[e] ſame; requiring at the ſame time the leaſt repairs of an[y] that can be uſed: And if the bellows ſhould be caſt iron they would laſt for ſeveral ages; and when caſt ſtrong, the[y] would not require any weight to ſink readily in the wate[r]. One might cauſe them to be cover'd with lead, or make the[m] of thin copper with a thick leaden hoop at top, to mak[e] them ſink. As to their ſhape, it is not abſolutely neceſſar[y] that they ſhould be of the ſame with that repreſented by th[e] Fig. For, in caſe one would not beſtow iron hoops on th[e] bellows, they might be made ſquare, in a triangle, or an[y] other ſhape, provided they be as wide again at bottom as a[t] top: And if they be made of wood, it will be neceſſary t[o] provide an edge round the tops, for containing as muc[h] ſtones or leaden weights, as will be found neceſſary to mak[e] them ſink readily, when they are lower'd down into th[e] water.

Laſtly, if we will conſider the charge of thoſe bello[ws] made uſe of at iron furnaces, as to the bellows themſelve[s], the water-wheel and its axle-tree, &c. and compare th[e] ſame with the coſt of theſe, we ſhall eaſily find a vaſt diff[e]-rence, not to mention the vaſt charges of keeping the com-mon bellows in repair.

In fine, the blaſt of theſe bellows is governed and m[o]-derated in the ſame manner as the common ones, *viz.* b[y] letting more or leſs water into the ſloping gutters, and b[y] taking out and letting in plugs for that purpoſe, placed i[n] holes near the top of the water-bellows.

An Abstract of Meteorological Observations for six Years, made at Padua; *by* S. Poleni. Phil. Transf. N°. 448. p. 239. *Translated from the* Latin.

THE following is an abstract of six years meteorological observations, which were made according to the rules of Dr. *Jurin*'s invitation; and consequently corresponding with those published in *Phil. Transf.* N° 421. The instruments *S. Poleni* made use of were the same, and posited in the same places, and applied in the same manner, as mentioned in that transaction. The observations are, as follows:

TABLE A.

	1731 In. Dec.	1732 In. Dec.	1733 In. Dec.	1734 In. Dec.	1735 In. Dec.	1726 In. Dec.
January	2 546	2 129	1 855	1 034	4 052	6 541
February	3 093	1 959	0 405	1 735	2 420	2 981
March	0 976	2 765	5 642	1 558	5 162	2 721
April	3 434	5 432	3 816	1 706	1 452	1 227
May	0 602	1 864	5 330	4 372	2 681	4 444
June	4 253	2 872	2 712	4 555	3 865	2 777
July	3 402	1 585	3 874	7 015	4 992	3 064
August	7 372	3 112	3 679	3 082	0 720	1 844
September	2 216	0 089	0 589	2 899	1 287	2 479
October	4 354	9 164	2 788	4 391	1 878	0 529
November	1 653	0 957	0 382	1 307	0 542	1 454
December	0 306	3 528	1 065	4 909	0 634	0 572
Sum of the whole year.	34 207	35 456	32 137	38 563	29 685	30 633

And first, the quantities of rain and snow water, collected for these six years, are exhibited in Table A: And if all the months of *January*, *February*, &c. of the said years, be added together, it will be found that the least quantity of water, namely 6 inches 295 dec. fell in the months of *November*; on the contrary, that the greatest quantity, *viz.* 23 inches 932 dec. fell in the months of *July*. Whereas in the six preceeding years, the least quantity fell in the months of *February*; and the greatest in the months of *October*, and the difference between the greatest and least quantity was 22 inches 196 dec. but in this 17 inches 637 dec.

It likewise appears from the table, that the year 1735 was drier than any of the rest, the sum for that whole year being

29 inc. 685 dec. and the year 1734 wetter, its ſum being 38 inches 563 dec. In the ſix preceeding years the difference between the drieſt and wetteſt years was 27 inches 505 dec. in the ſix years of this table 8 inches 878 dec.

TABLE B.

	Winter. In.	Dec.	Spring. In.	Dec.	Summer. In.	Dec.	Autumn In.	Dec.
1731	5	759	6	647	13	598	8	17
1732	4	522	10	300	7	226	10	186
1733	6	321	15	758	8	762	3	759
1734	4	74	8	14	14	34	10	125
1735	10	450	10	848	7	805	2	337
1736	11	945	8	54	6	361	4	588
Sum.	43	71	59	621	57	796	40	12

In this table B it eaſily appears, that the quantity of water gather'd in ſummer and autumn for three years was greater than that gather'd in winter and ſpring; but that for three years it was leſs: Whereas in the ſix preceeding years the quantity in ſummer and autumn was always greater; and in theſe ſix years the ſeaſons were to be ranged according to the increaſe of the ſums of water gather'd in the following order, winter, ſpring, ſummer, autumn: In the ſix years of Table B they ſhould be ranged thus, autumn, winter, ſummer, ſpring.

In theſe laſt ſix years, the ſum of the quantity of water collected in ſummer and ſpring exceeds that collected in winter and autumn. And in both the ſix years, ſummer is refer'd to the two ſeaſons of the greateſt, and winter to the two ſeaſons of the leaſt quantity.

TABLE

TABLE C.

The decrease of the barometer from the noon of the preceeding day to that on which it rain'd		The increase of the barometer from the noon of the preceeding day to that in which it rain'd.	
Number of days in which it rained.	The wind what at the noon of the days it rain'd.	Number of days in which it rain'd	The wind what at noon of the days it rain'd.
140	N	80	N
47	N E	29	N E
15	E	7	E
18	S E	4	S E
27	S	14	S
28	S W	17	S W
33	W	24	W
62	N W	31	N W
Sum 380		Sum 206	

As in the corresponding table for the former six years; so in this, there was no greater difference between the numbers of increase and decrease of the height of the barometer in rainy days, than what is between the numbers 370 and 206; which is almost the same with that for the former six years, namely, 378 and 211.

It is likewise worth remarking, that in all the former six years, there were 589 rainy days; and in the latter 576, there being only the small difference of 13 days between both the six years; and likewise in both the six years there was a greater quantity of rain with a northerly than with any other wind; and the least quantity with a S E and E. Moreover, the same things are to be understood in the above Table C, as in that in *Phil. Trans.* N° 421.

Table D

The decrease of the barometer from the noon of the preceding day to that of the day it ſnow'd.		The increase of the baro- meter from the noon of the preceding day to that of the day it ſnow'd.	
Number of days it ſnow'd.	The wind what at the noon of the days it ſnow'd.	Number of days it ſnow'd.	The wind what at the noon of the days it ſnow'd.
3	N	5	N
1	N E	2	N E
1	W	1	S W
1	N W	1	W
Sum 6		Sum 9	

In the former ſix years it ſnow'd in the decreaſe of the baro- meter for more days than in the increaſe: But the contrary may be ſeen in the above table D. In the former ſix years there were 18 ſnowy days, and in the latter ſix, 15.

Table E

	The ſum of the heights of the barometer.		The ſum of the heights of the thermometer.		The mean height of the barometer for each day.		The mean height of the thermometer for each day.	
	Inches	Dec.	Inches	Dec.	Inches	Dec.	Inches	Dec.
1731	10850	65	18286	25	29	72	50	9
1732	10870	19	18361	30	29	70	50	17
1733	10867	18	18301	95	29	77	50	14
1734	10850	24	18305	78	29	73	50	15
1735	10861	21	18274	87	29	76	50	6
1736	10870	7	18338	42	29	70	50	10

In the table E may be ſeen the ſums of the heights of the barometer and thermometer for each year; as alſo the mean heights correſponding to each day.

For the whole laſt ſix years, the mean height of the baro- meter, referable to each day of the ſaid ſix years, is 29 inches 73 dec. differing only, 03 parts from that of the former ſix years, which was 29 inches 70 dec.

And likewiſe the mean height of the thermometer for each day of theſe laſt ſix years is found to be 50 inches 12 dec. dif- fering only ,04 parts from that of the former ſix years, which was 50 inches 16 dec.

In general, the mean heights both of the barometer and thermometer for each day in each year differ but little in this table; as they likewise very much agreed in the table of the former six years.

Table F

Years	Months	Day O. S.	Hour h.	Hour ′	Greatest height of the barometer. Inc.	De.	Least height of the barom. In.	Dec.	The height of the thermo. In.	De.	Winds	Weather.
1731	Feb.	6		15	30	26			48	36	N W	Fair
	Jan.	29		15			28	70	47	92	S E	The air dark.
1732	Dec.	10		15	30	20			48	32	N	Fair.
	Mar.	11	2				28	85	49	67	S W	Sky overcast.
1733	Jan.	23		15	30	48			48	62	N W	Fair.
	Mar.	19		15			28	96	49	18	N	Rain.
1734	Jan.	12		15	30	34			48		N	Fair.
	Dec.	15		15			28	88	48	30	S	Sky overcast.
1735	Feb.	8		15	30	30			48	40	N W	Sky almost overcast.
	Mar.	17		15			29		49	48	W	Small rain.
1736	Nov.	19		15	30	20			48	70	N	Fair.
	Feb.	12		15			28	88	48	74	N W	Sky overcast

Table G

Years	Months	Day	Hour h	Height of the barometer. Inc.	Dec.	Greatest height of the thermometer. Inc.	Dec.	Least height of the thermometer. Inc.	Dec.	Winds	Weather.
1731	Jun.	29	15	29	80	52	40			S E	Fair.
	Jan.	27	15	29	30			47	44	N W	Small rain.
1732	Jul.	20	4	29	62	52	52			N W	Sunshine and clouds alternately.
	Dec.	6	15	29	55			47	75	W	Fair.
1733	Jun.	29	15	29	86	52	38			N W	Fair.
	Dec.	13	15	30	10			47	85	W	Sky almost overcast.
1734	Jul.	1	15	29	70	52	24			N E	Sunshine and clouds alternately.
	Jan.	14	15	30	12			47	92	S W	Fair.
1735	Aug.	26	15	29	78	52	18			W	Fair.
	Dec.	27	15	30	14			47	74	W	Sunshine and foggy.
1736	Jul.	22	15	29	90	52	30			N E	Fair.
	Dec.	20	15	29	78			47	92	W	Sky overcast.

S. *Poleni* has added the tables F and G, in which are shewn the greatest and least heights both of the barometer and thermometer. By comparing them with the corresponding tables of *Phil. Transf.* N° 421 we may see, that the greatest height of the barometer, namely 30 inc. 48 dec. exceeds that in the former six years, which was 30 inc. 40 dec. But the falling of the mercury to 28 inc. 70 dec. is less than that in the former six years, which was observ'd to be 28 inc. 56 dec.

In these latter tables the greatest height of the thermometer is 52 inc. 52 dec. and in the former 52 inc. 54 dec. the difference being ,02 only: But the least height in these tables is 47 inc. 44 dec. in those 47 inc. 58 dec. The mercury, therefore, fell in the latter six years lower by 14 dec. than it had ever done in the former six years.

Table H.

Years N. S.	Inc. of a *Paris* foot.	Lines
1731	31	11 $\frac{3}{5}$
1732	30	$\frac{1}{7}$
1733	32	5 $\frac{2}{5}$
1734	35	5 $\frac{1}{2}$
1735	28	7 $\frac{4}{5}$
1736	29	2 $\frac{4}{5}$
	Sum 187	9 $\frac{1}{3}$

By dividing into six equal parts 187 inc. 9 $\frac{1}{3}$ lin. (the numbers got from the sum of this last table H) the mean measure of water for each year is 31 inc. 3 $\frac{7}{12}$ lin. But in the former six years it was found to be 35 inc. $\frac{2}{12}$ lin. The difference, therefore, is 3 inc. 9 lin.

And if we bring the sums of both the six years into one sum, and divide it by 12, we shall find 33 inc. 2 $\frac{1}{2}$ lin. to answer to each year: And if this quantity (as has been done in the former six years) be compar'd with the mean quantity of water, that falls at *Paris*, namely 19 inc. or 18 inc. 8 lin. it will still plainly appear, that a much greater quantity of water falls at *Padua*, than at *Paris*.

And these six years do likewise furnish with an observation, by which it appears, that sometimes in 24 hours there falls a much greater quantity of water at *Padua* than ever does at *Paris*

Paris in the ſame time. From the noon of the 27th of *Oct.* 1732, O. S. the wind at north, till the noon of the following day, there fell 2 inc. and 9 lin. of rain nearly. Moreover, the exceſs of this quantity above that (within the time already ſpecified) which falls at *Paris* may be eaſily known by comparing the *Memoirs of the Royal Academy of Sciences*, as S. *Poleni* has hinted elſewhere.

The greateſt height of the barometer on *Jan.* 23, 1733, obſerv'd theſe laſt ſix years, and reduced to *Paris* meaſure, is 28 inc. 6 $\frac{2}{10}$ lin. and the leaſt height anſwering to the 29th of *Jan.* 1731 is 26 inc. 10 $\frac{2}{10}$ lin. The difference between the greateſt and leaſt height, is found to be 1 inc. 8 lin.

And ſince the difference (as has been mention'd in *Phil. Tranſ.* N° 421) between the greateſt and leaſt height of the barometer at *Paris* is found to be 1 inc. 11 $\frac{1}{6}$ lin. it exceeds that found by S. *Poleni* at *Padua* by 3 $\frac{1}{6}$ lin. Wherefore, what has been obſerv'd of theſe differences in the ſaid *Tranſaction* is confirmed by theſe later obſervations.

In fine, S. *Poleni* adds ſome obſervations on the declination of the magnetic needle. In *April*, 1733 he found by repeated obſervations that the declination was 13 degrees and $\frac{1}{2}$ weſtwards. On the laſt days of the year 1736 he found it 13 degrees and 45 ſexageſimals. If, therefore, what has been already ſaid of the declination of the needle in *Phil. Tranſ.* N° 421, be compar'd with this, it will plainly appear, that the declination for the 3 firſt of theſe ſix years increas'd more than it did for the three laſt.

The imperfections of the common Barometers, *and the improvement made therein; by Mr.* Charles Orme; *together with ſome Remarks; by Mr.* Henry Beighton. Phil. Tranſ. N° 448. p. 248.

AS there is nothing more wanting than a theory of the weather on mechanical principles; there does not ſeem any thing in all philoſophy of more immediate concern than the ſtate of the weather.

In order to which a complete hiſtory of the weather is neceſſary, to deduce from thence ſuch rules, and obſervations, as may in ſome meaſure form ſuch a theory: And it may be ſaid, that could we in any tolerable degree foretell but by ſome ſmall ſpace of time, the change of the weather, it would be of admirable uſe to us in thoſe affairs on which the chief part of our welfare and ſubſiſtence depends.

It was from such considerations, that upwards of 20 years before Mr. *Orme* began, and had continu'd to keep a diary of the weather, (the six last years of which he here subjoins) and tho' he pretends not to form a just theory upon them, yet he is not without hopes they may have their uses, when they fall into abler hands.

From them, and the observations he made by a new improvement of the barometer (for the same number of years) he could generally foretell for a day, or perhaps two, the change of weather, or its continuance.

And tho' so many ingenious and curious persons, since the invention of *Torricelli*'s barometer, have been improving and endeavouring to bring that machine to perfection; yet notwithstanding all their indefatigable care and pains, the air that is intersperfed and mixed with all fluids (of which mercury is reckon'd one) has in some measure frustrated their labours, and it has remained imperfect: For, whilst there are any small quantities or particles of air remaining in the quicksilver, it will be constantly rising in hot weather, and falling in cold; which really perverts the very end and design of a barometer, which should shew the pressure of the air, and foretel when either fair weather or rain is coming: Instead of which it is in great measure a thermometer, foretelling heat instead of fair, and cold instead of rain and stormy weather: And these imperfections are more or less in all the various sorts of barometers hitherto invented.

The barometer Mr. *Orme* is going to describe is not different in form from some usually made, it being of the diagonal kind, from whence the more minute alterations are more readily discover'd: Of this form several have been made by the late ingenious Operator Mr. *Patrick*, who has, in his way, deserved well of the curious: And who, tho' he had done so much towards proving the weight of the atmosphere, by which the mercury in the tube was sustain'd, did himself not believe it, but run into the absurdity of the funicular hypothesis.

There is an inconveniency or imperfection in most, if not all, those diagonal barometers: For after some time, the various rising and falling and changes of the weather, of heat and cold, the small particles of air that have been intersperst in the mercury, have got together in a larger mass, as they will incline by attraction, which will separate the mercury; and that quantity of air will be dilated by heat, and contracted by cold; so as to spoil the design thereof.

 Besides,

Besides, there is such a cohesion of the mercury to the tube (especially in the small ones) that after some time, the mercury that is not truly cleans'd from its dross, and purg'd of all its air, will in remarkable changes of the weather, neither rise nor fall: All which embarrassment is taken off, and the difficulties surmounted in Mr. *Orme*'s improvements of the barometer, by the following method.

I. The quickfilver is entirely purified from its dross and earthy particles by distillation; and when the tube is fill'd with a pound and a half, two or three pounds of mercury, and all the air got out by the usual methods in filling tubes, then the remaining air is discharged by such an intense degree of fire, as makes the mercury boil; by which ebullition an innumerable quantity of small particles are emitted, and blow with a great velocity at the open end of the tube, till all the air be quite cleared out; which curious as well as laborious operation is continued for the space of four hours: And when no more bubbles would rise in the tube, it remain'd whole, with its mercury of a very lively sparkling brightness, with this difference only, that the mercury, so purged of its air, did not fill the tube so high, as when first put in by about two inches; which is a plain demonstration, that in that tube, which was 49 inches long, there was intersperst in the mercury at first filling it, so much air as would fill two inches of the said tube, which was a twenty fourth part of the said space.

The whole operation Mr. *Orme* himself attended the 20th of *January*, 1734-5.

And farther, he can affirm, that every part of the mercury boil'd for a long time, and the tube became gradually so red hot, that with a warm knife he could make impressions in any part of it.

And that this is the surest, if not the only, method for getting out all the air, may be judged by the boiling of water, which in its ebullition emits a great quantity of air for a considerable space of time.

As to the perfection of these barometers, they exceed all others Mr. *Orme* ever observ'd in the following particulars.

1. They are sensible of the most minute changes of the air.

2. They foretel the weather by a much longer space of time than others, as for the most part 20 hours, sometimes 36 or 48 hours: Nay, before great storms, and such rains as cause great floods, for a much longer time before they happen.

3. Tho' they are so sensible of such minute changes of the air

air, yet the most intense heat will not raise them a hair's breadth, nor the greatest cold make them fall. This shews they are perfect barometers, and not in any degree thermometers.

4. You may distinguish by them, whether (if they shew for rain) it will be little or much.

5. As by other barometers you cannot tell the weather, but by a past and a present observation; these tell you the instant you come to them, what the weather is going to be: For, by rapping the case with your finger, if it is going to be fair, or very fair weather, the mercury will rise that moment, a 10th of an inch or more; but if for foul, it will scarce make any sensible rise.

Mr. *Orme* has had one of the glasses by him for 10 years, and he has constantly observed its motions, which has very seldom fail'd him in foretelling any considerable change of the weather.

Mr. *Beighton* makes the following remarks

1. Tho' you can foretel it will rain on the morrow, it is impossible to tell where the rain will fall: For, as every shower has space, i. e. length and breadth, if it rains in that particular field, yet it may be fair in the next adjoining.

2. The barometer does only shew the pressure of the atmosphere, and inclination of the air, in and about the country where it stands, and not always in a particular spot: So that in foretelling of great rains, tho' they be over us when the glass fell; yet the wind which bloweth where it listeth, carries the clouds and rain with it.

3. On the mercury's falling it is very hard to distinguish, whether it will be rain or high winds, they equally causing the mercury to subside.

4. Of all who guess at the weather, it is observable it is not true one time in ten, nor do any two of them agree about it.

But from observations on this barometer, it will seldom fail you once in 20: So that it is above 100 to 1 preferable.

5. If from the state of the mercury, for instance, yesterday and this morning, it be pronounced, next day will be no rain, and one look at the glass no more that day, perhaps winds may arise and so alter the weight of the atmosphere, and the glass falls considerably, it will rain on the morrow, contrary to what was at first expected.

Hence it is evident from these remarks, that judgments are formed on the weather from barometers, which do not

prove so; and this begets an opinion in the vulgar and ignorant, that there is no judgment at all to be formed from them.

If the barometer could only foretel very great and remarkable changes of the weather; for instance, in harvest time, that a very great rain, or perhaps floods, were coming, the husbandman would stop cutting down his grain, and save some of it being spoil'd by the wet. Or on a journey, if a person knows from the indications of the barometer, that if he does not get home by such a time, or pass such rivers, the floods will be so great as not only to prevent him but endanger his life, and this must be reckoned of considerable service.

The greatest storm that has been in our days, was *Jan.* 8, 1734 5. On the 5th the mercury began to fall, and on the 8th it was a 10th below 28 inches; which has not been observed in this age, nor perhaps since *Torricelli*'s time: Thence one could plainly indicate, that it would be the greatest flood ever heard of, or the greatest storm ever felt; the latter of which it prov'd.

Some rules and observations for foretelling the weather by the rising and falling of the mercury.

Tho' rising always presages fair, and falling, foul weather; yet there are several difficulties and niceties in forming a judgment from them, and herein consists the chief art.

Most of the observations, made by Dr. *Halley*, Dr. *Beal*, Dr. *Derham*, Mr. *Patrick*, and others, are applicable to this improv'd diagonal barometer.

Mr. *Beighton* inserts here some few observations for the improved diagonal barometer, which he believes may be reckon'd rules as he has deduced them from time to time, in using Mr. *Orme*'s glasses, and keeping a register of the weather.

1. This barometer very rarely foretells thunder, seldom falling at all before it, which Mr. *Patrick* observes others do.

2. In serene and hot weather, when the mercury is high and rising, and there is all the possible certainty of fair weather the next day, and if there happen to fall great showers, you may conclude they have been driven upon you by thunder, tho' you have heard nothing of it.

3. When the mercury is pretty high, and has fallen to foretel rain, and it rises again before the rain cometh; it indicates that there will be but little of it.

4. If the mercury continues falling whilst it rains, it shews it will rain next day.

5. In

5. In fair weather when the mercury has continued high or rising, if it falls a little to day about noon, and towards the evening rises again, you must expect a single shower the latter part of the next day (or perhaps by noon) and then fair weather again forward.

6. When the mercury rises gradually about half a 10th perpendicular height, and continues so to do for many days together; you may reasonably expect a fair season for as long a time as it was rising, unless some gales of wind intervene especially the S W b S, or thereabouts.

7. When the mercury rises or falls very fast, neither the fair or foul weather it forbodes will continue long.

8. Without knowing how the mercury has stood some little time before, a true judgment cannot be formed at all times: For suppose, I find it in a rising condition, I am apt to think it will be fair; but if it had been higher some hours before, and fell, there must happen a shower.

Why the mercury in the diagonal barometer (if it be for fair weather) on rapping the case several times, which jars and makes the tube tremble, will rise at every stroke for several strokes together, and in all sometimes a tenth of an inch or more in the perpendicular, may, Mr. *Beighton* presumes, be thus accounted for.

1. There is a cohesion of the mercury to the tube, which hinders its rising, and such rapping releases that.

2. But its observable, that it will rise a little at all times, even when it is in a standing or even in a falling condition: This may be accounted for thus . . . .

The mercury and atmosphere are in *æquilibrio*; and rapping starts and raises the mercury a little in a boiling manner, especially its upper surface, which is observ'd to leap, or be in a swimming posture; then the pressure of the atmosphere overbalances the remainder of the mercury, and it must rise a little.

Or such violent jarring puts the mercury in a lateral and upward motion (for, downward it cannot go) which takes off its gravity, as the winds lessen the pressure of the air; therefore, it must rise a little. . . . .

But then it is also observable, that if the mercury was in a standing or falling condition; such rising as above will in a minute come to the same place again; and even when the mercury is in a rising condition it will in that space of time fall a little part of what it rose by such rapping.

This barometer has the coruscations, as they were observ'd in Mr.

Mr. *Patrick*'s pendant one: For, by rapping the case wi the finger in a dark place, it will emit several bright flashe along the empty part of the tube.

This Mr. *Beighton* takes to be an argument that the vacuu is very pure; and the mercury truly purged.

Mr. *Beighton* adds, that he can with truth affirm, that in al the affairs of husbandry, but especially in harvest, it has fel dom fail'd him in foretelling the weather so well, as to be very advantageous to him for 9 years together, and so pleasing an entertaining at other times, that he could not be without one o these barometers.

The following are Collections from the diary of the wea ther and barometer, in order to settle rules for foretelling th weather from the latter.

Great STORMS.

Before them the mercury falls 3 or 4 days, and is exceeding lo

	1734-5.				
Jan.	4	at night the mercury at	29.	92.	inches.
	5	night	29.	66.	
	6	night	29.	2.	
	7	night	28.	1.	
	8	noon	27.	9.	lower by $\frac{1}{10}$. tha

has ever been known, and the greatest storm of wind eve heard of in this age, in the south of *England*; as also in *Fran* and *Holland*.

	1736.				
Jan.	31.	. . . .	29	47	
Feb.	1.	. . . .	29	15	
	2.	. . . .	28	39	rain and storm
	1734.				
Aug.	11.	. . . .			stormy.

Great FLOODS.

Before which the mercury falls very considerably

	1735.				
Sep.	4.	. . . .	29	7	
	5.	. . . .	29	6	
	6.	night	29	6	
	7.	. . . .	29	25	the greatest floo

(at *Coventry* being about the middle of *England*) that has bee these forty years, and yet the mercury fell but little.

1735

	1735.				
Oct.	23.	. . . .	29	55	
	24.	night	28	8	
	25.	night	28	78	
	26.	. . . .	28	85	
	27.	. . . .	28	26	great flood.
	1735.				
Aug.	19.	. . . .	29	3	
	20.	. . . .	29	28	
	21.	. . . .	29	3	
	22.	. . . .	29	2	
	23.	. . . .	29	2	stormy, great rain.
	24.	. . . .	29	38	floods.
Dec.	2.	. . . .	29	32	rain.
	3.	. . . .	29	5	fair.
	4.	. . . .	28	8	rain.
	5.	. . . .	28	9	rain.
	6.	. . . .	29	5	fair.
	7.	. . . .	29	52	great rains and floods.

THUNDER.

The mercury ſeldom falls for rains that come by thunder. *Vide Diary June* 2, 1735.

THUNDER,

When the mercury did riſe.

	1733.							
June.	21.	—	29	16	—	29	56	
	22.	—	29	56	—	29	56	
	23.	—	29	62	—	29	65	hot.
	24.	—	29	65	—	29	57	ſultry.
	25.	—	29	54	—	29	52	ſultry.
	26.	—	29	51	—	29	59	great thunder.
	27.	—	29	57	—	29	56	a very violent

thunder from 10 in the morning till one in the afternoon, doing a deal of damage.

	1735.							
June.	1.	—	29	3	—	29	8	
	2.	—	29	4	—	29	55	thunder and great rains.

THUNDER

The mercury fell before it, 1733.

1733 *July* 27.	—	29	44	hot, fair.
28.	—	29	37	wind. rain.
29.	—	29	09	violent thunder.
1734 *Aug.* 7.		29	59	sultry
8.		29	46	fair
9.	—	29	25	thunder
10.	—	28	87	rain, thunder

FROST.

A frost, when the mercury is high, brings rain.

1731. The mercury was high all the month of *March*, and no rain, but what followed the frost on the 17th and 29th.

Dry SEASON.

In *June* 1729, the mercury scarce ever above changeable.

In *Aug.* 1730. the mercury never lower than 29, 37.

1731. From the first to the tenth of *Aug.* and rain came the 16th, tho' the mercury was rising.

FROST

A great frost, tho' the mercury fell, but it was attended with a great snow, which might occasion the mercury to fall.

1731 *Jan.* 1.	—			—	29	56	rain
2.	—	29	46	—	29	12	rain
3.	—	28	78	—	28	72	wind
4.	=	28	72	—	28	81	frost, great snow
5.	—	28	93	—	29	12	snow, frost

Great RAINS.

Tho' the mercury was rising.

1732 *May* 1.	—	29	28	—	29	25	wind
2.	—	28	21	—	29	25	rain all day [snow hard from 8 to 1[illegible]
3.	—	29	34	—	29	09	rain
4.	—	29	09	—	29	09	rain
5.	—	29	12	—	29	34	wind
6.	—	29	44	—	29	46	fair
7.	—	29	52	—	29	39	rain and great [floods

Great rain, tho' the mercury fell but little.

1733 May 24.	—	29	6	—	29	54	wind
25.	—	29	51	—	29	54	fair
26.	—	29	52	—	29	54	fair
27.	—	29	5	—	29	39	violent rain for more than 11 hours

Great RAINS.

The mercury falling very much.

1734 July 10.	—	29	65	—	29	67	fair, hot
11.	—	29	63	—	29	62	fair, hot
12.	—	29	59	—	29	4	rain
13.	—	29	29	—	29	13	great rains

— The mercury falling a great while before the rain came, and the rain continued as long.

1736 May 19.	—	29	75	fair, wind	29	8
20.	—	29	8	cold wind, fair	29	7
21.	—	29	65	cold wind	29	52
22.	—	29	39	wind, clouds, rain	29	52
23.	—	29	28	cloudy, fair	29	27
24.	—	29	32	fair	29	35
25.	—	29	32	cloudy, wind, rain	29	24
26.	—	29	15	rain	29	15
27.	—	29	12	rain	29	2
28.	—	29	28	rain	29	23
29.	—	29	37	wind, cloudy, rain		

1735 Feb. 22.	—	29	43	
23.	—	28	82	
24.	—	28	9	great rain.
25.	—	28	76	

The mercury generally falls just after hot or sultry weather. *Vide* 16. *Sept.* 1731.
8. *Aug.* 1734.

There generally follow high winds after the *aurora borealis*.

1733 *Oct.* 27. A large *aurora borealis*; and the 28th, 29th, and 30th high winds.

Vide 23. *Jan.* 1734

 The

The mercury falling pretty much, and neither wind no[r] rain succeeded.

1733

From the 18th to the 21st it fell 41; and no wind or rai[n] at all till the 25th.

Sultry weather generally makes the mercury fall soon after.

1734 *Aug.* 8. After a great storm the mercury rises very fa[st]

1736 *Feb.* 6.

1734 *Aug.* 26.

Before great winds the mercury falls very soon.

1736 *Feb.* 8.

1736 *Feb.* 8.

The mercury below 28 inches.

1734 *Dec.* 15, at 27 9

1735 *Jan.* 8. 27 9

In winter before frost, the mercury rises pretty fast,

1735 *Dec.* 12.

Before a thaw the mercury falls.

1735 *Dec.* 13.

17.

1736 *Feb.* 9.

The mercury falls suddenly before a great snow.

1731 *Jan.* 4.

1736 *Feb.* 8.

Feb. 21.

When the mercury falls for high winds, and it continues [to] fall when that wind is come, it is likely to be tempestuous, [or] continue some time, unless rain succeed.

1736 *Nov.* 22.	--	29	62	fair, warm	29	62			
23.	—	29	49	windy, warm	29	32	wind		
24	29	1	high wind	28	88	28	73	storm[y]	

Some of these collections are entirely contradictory t[o] any settled rules; and such will happen, and others confir[m] them: But Mr. *Beighton* has collected so very few of [this] sort, that till more are in this manner collected, it will b[e] doubtful to form any rule from them.

Sulphureous Vapours from a cavern in a Stone quarry at Pyr[mont]; *by Dr.* Seip. Phil. Transf. N° 448. p. *266. Tra[n]slated from the* Latin.

THE stone diggers frequently found dead birds in [a] certain deep pit of this stone quarry, 800 paces fro[m] the *Pyrmont* springs; and sometimes different species of bir[ds] that were newly dead.

The

The Doctor, curious to find out the cause of the birds death, at first suspected some mineral poisonous matter, like cobalt or orpiment, intermix'd with the stones, and dissolv'd by the rain water, of which the birds when thirsty, probably, drank.

Upon his going down into the pit, and stooping to take out the birds, he was immediately struck with such a penetrating sulphureous stench, that giddy and asthmatic, he was obliged to fly for it.

The Doctor therefore judged, that that suffocating sulphureous steam was of the same nature and origin with what is observed evening and morning in a clear sky and calm dry weather on the *Pyrmont* springs, where birds no sooner draw near than they are suffocated; and ducks, that swim in a larger spring, commonly used for bathing, can scarce hold it out a few moments, but die away immediately.

The Doctor indeed thought it would be far from adviseable, but rather a dangerous and noxious experiment, to make more such vents and spiracles for the *Pyrmont* springs, and draw out from the bowels of the mountains the sulphureo-spirituous steams that ought rather to be suppress'd and pent up for impregnating and sharpning the subterraneous waters.

For this reason, therefore, and by the Doctor's advice, the Prince of *Waldeck* discharged the workmen from digging deep into the quarry, to avoid giving vent to the mineral vapours.

However, for curiosity and experiment sake, the Doctor obtain'd of the Prince a spot of ground for a dry bath of six foot square, which he caused to be arch'd over with stone, and closed up with a door.

This small cell, order'd in this manner, can so much the less draw off the sulphureo-spirituous virtue of the waters, as it is certain that that vapour does not always perspire, but only when the weather is fair and calm, and the sky serene, with easterly and dry, northerly winds, not stormy, but gently blowing, and with fogs and vapours arising before thunder and lightning.

The steam likewise is only found morning and evening; and as the sun gradually ascends, so the vapour descends, and towards noon retires under the stones, and entirely vanishes; about evening, it by degrees returns, and after sun-set it comes out again very plentifully.

This vapour is not unlike fogs and watry exhalations; and yet it is never visible but in the rays of the sun, when the

 tre-

tremulous motion of the vapour appearing like lightning and arising at very ſhort intervals from the ſtones, preſent itſelf to view.

Generally the exhalation keeps in an horizontal direction and ſcarce aſcends and exerts its force beyond 1, 1 and ½ and two foot: So that if one go down into the pit, and ſtand upright therein any time, and not bend the head below the ſaid horizontal line, he ſhall not perceive the ſmell.

Yet at certain times, eſpecially when the ſky is calm, ſerene and very dry, and pregnant with thunder and lightning, the vapour aſcends and exerts its ſuffocating force, 5, 6 foot and upwards: But this ſeldom happens.

The chief phenomena and experiments of this mineral exhalation, hitherto obſerv'd, are the following.

1. Upon going into the cavern and keeping the body and head erect, one ſhall perceive no ſmell at all; and upon ſtanding a few minutes in it the feet grow warm, and the ſteam immediately penetrates thro' the thickeſt ſhoes, and like burning nettles excites in the ſkin a ſtimulating ſenſation, that gradually extends to the legs and thighs, and warms the lower parts of the body in ſuch manner, that one would think himſelf amidſt a fire.

Upon ſtanding ſtill for a ſhort while in this manner; a very plentiful ſweat is raiſed, firſt in the inferior parts, and at length over the whole body, without any trouble or anxiety.

2. Upon bending the head towards the bottom of the pit, a very ſtrong ſmell is immediately perceiv'd, reſpiration ſuppreſſed; an acrimony felt in the eyes, which makes them water, like garlick or horſe-radiſh; the mouth and jaws filled with a ſulphureous taſte, the head affected with a vertigo and drowſineſs; ſo that to avoid being ſuffocated and falling down, one is obliged to retire.

3. All kinds of inſects, as flies, butterflies, beetles, &c. as ſoon as they come near the vapour, immediately drop down and die.

4. Sometimes the ſmaller birds, if the ſteam be very copious are ſuffocated the moment they come into it; and oftentimes for a few moments, as ſeis'd with convulſions, they flutter about and leap, open their becks, breathe ſhort, and imitate the geſtures of animals included in an exhauſted receiver; and at length they die.

If the time be exactly obſerv'd when the birds drop down and begin to faint, but are not quite dead, and they then be ſpeedily

ſpeedily brought into the open air, but eſpecially if water be pour'd into their mouths; they gradually awake as from a deep ſleep, and revive, and ſoon return to themſelves in ſuch manner as to become perfectly well, and continue ſo ever after.

And thus the Dr. has ſeen a bird for ten times in one day fall into ſuch ſwoons and recover again, and continue well for a long time after.

5. The larger birds, and tame fowl, as hens, ducks, geeſe, &c. hold it out longer in the pit, eſpecially if they ſtand with their long necks above the horizontal line, or by repeated leaps get above the ſphere of the vapour's activity, and ſo at times breathe the free air: But if the vapour be copious or if their heads be kept down to the bottom of the pit, they at length undergo the ſame fate with the ſmaller birds.

6. Quadrupeds; as dogs, cats, ſheep, &c. the larger and ſtronger they are, the longer they continue without being ſuffocated, and at length they die as birds do.

Yet they recover much more eaſily in the free air, eſpecially if they be plunged into water, or a deal of it be pour'd upon them.

7. This ſteam immediately extinguiſhes fire, eſpecially flame, and candles, whether included, or not, in tranſparent veſſels.

It is an agreeable phenomenon if a torch made up of a bundle of ſtraw be kindled and inclined to the bottom of the cavern; for, it is immediately extinguiſh'd; but rais'd again above the ſphere of the exhalation into the free air, it directly breaks out again into flame; and thus alternately, as often as one pleaſes.

8. When the vapour is copious and ſtrong, gunpowder cannot be fired at the bottom of the pit.

Sparks, ſtruck by a ſteel from pyrites or flint, may fall upon gun-powder, but not fire it.

In 1724, when firſt the Dr. caus'd wall in and arch over his vaporous bath, he thought with himſelf how he might apply to the benefit of mankind ſo ſurpriſing a vapour, which is much more ſubtile and penetrating than any of our chemical ſpirits.

For, he did not find it arſenical nor corroſive, as that from burning ſulphur; not inhering to, nor corroding the lungs, but only retarding and taking away one's breath and reſpiration: Yet not ſo ſuddenly in man, as not to give him ſufficient time to retire.

For

For experiment ſake the Dr. has frequently ſtaid in the cavern as long as he could bear the vapour, till he was almoſt faint and ſuffocated; he has ſuck'd it in with his mouth wide open, and at length he has jumped into the open air: He never felt any bad effects from thence, but rather found his breaſt and reſpiration become lighter; being troubled with a catarrh and cough he ſometimes found that catarrhous obſtructions and collections of matter were by means of this fumigation diſſolved and diſcuſſed.

There is not under the ſun a ſhorter and eaſier method of procuring ſweat: For, after ſtaying a few moments in this vaporous pit, ſweat plentifully breaks out all over the body.

Some country people, upon going ſometimes into the cavern affirm that ſwellings of the legs, rheumatiſms and arthritic pains have been very much reliev'd by this ſteam.

But becauſe the exhalation ſometimes exceeds its uſual ſphere and is then too ſtrong and intolerable, the Dr. was afraid leſt ſome unwary raſh perſon ſhould ſtay too long in the cavern and endanger his life; he therefore choſe rather not to make any experiments than endanger people's lives.

Barometers and thermometers, put into this vaporous pit ſuffer no change; but remain in the ſame ſtate as in the free air.

The Effects of Dampier's Powder, *in curing the Bite of a mad* Dog; *by Mr.* Fuller. Phil. Tranſ. N° 448. p. 272.

MR. *Fuller* had us'd the *lychen cinereus terreſtris* with black pepper upon dogs, and always with ſucceſs; and ſome years before, a mad dog or cat (he forgets which) had bit ſome children and the mother at *Battle*; and mixing the *Lychen* according to *Dampier*'s direction, they all took it, as well as a dog or two that had been bit, and none of them had any bad effects from the bite.

Chriſtmaſs, 1737. a neighbour's ſervant going to ſearch whether a dog ſuſpected to be mad had been wormed (which dog died mad in 3 or 4 days after) was bit very much in both his hands: He went to a perſon who had had ſuch ſucceſs in uſing the *lychen cinereus terreſtris* with pepper for the bite of a mad dog, as to be applied to far and near, and who aſſured Mr. *Fuller* he would venture his life, that he cured any man or animal that was brought to him within 3 or 4 days after the bite. The ſervant took his medicine every day; about 10 or 11 o'clock he complain'd of a violent heat and pain in his head, which Mr. *Fuller* ſuſpected was the effect of the bite, and not the me-

dicine

dicine: But after he had taken it for ſuch a ſtated number of days, he grew better, and continued well ever after. He had tied his fingers with ſhoemaker's *ends* (which are often uſed for a cut) and they were all very much inflamed and very ſore. Mr. *Fuller* made him take them off, and all his plaiſters, and waſh his hands with ſalt and water, and in a fortnight's time they were quite well.

Another Caſe of a Perſon bit by a mad Dog; *by Mr.* David Hartley *and Mr.* Francis Sandys. Phil. Tranſ. N° 448. p. 274.

ABOUT the latter end of *Nov.* 1732, Mr. *Soame*'s groom was bit in the hand by a mad dog, ſo as to fetch blood. On the 4th day, when Mr. *Sandys* firſt ſaw it, the wound was heal'd; but it was open'd again by him, and kept ſo for ſome time, but at laſt heal'd ſooner than was intended, thro' the ſervant's neglect.

He was bled, took a purge, after that half an ounce of *pulvis Antilyſſus* (vide *Phil. Tranſ.* N° 237 and 443) every morning for three mornings; and was order'd to go into cold water every day for ſome time; but he neglected it after the third day: Beſides, Mr. *Sandys* order'd him to forbear all meats, and drink nothing but water. He continued in this regimen for about five weeks; then finding himſelf well, would confine himſelf no longer to it.

On the 7th of *Jan.* following he was ſeized with a ſickneſs, vertigo, and faultering in his ſpeech and memory; and at laſt his vertigo increas'd to ſuch a degree that he fell down twice in the ſpace of half an hour; and the laſt time did not recover his ſenſes, till he was put to bed, and blooded to the quantity of 18 or 20 ounces. The patient continu'd all night reſtleſs and ſullen, and in the morning was blooded again to the quantity of 15 ounces. Mr. *Hartley* was ſent for and came about 8 at night, and found him very ſullen, thirſty, but averſe to drinking, and his pulſe quick and hard. He ordered him to be put into the cold bath: About midnight his pulſe riſing, the Dr. ordered him to be blooded to the quantity of 16 or 18 ounces: The patient continued reſtleſs all night. About 8 in the morning he went into the cold bath again. About 10 Mr. *Hartley* going away left it as his opinion, that the could bath and bleeding ſhould be freely repeated, as the circumſtances ſhould require. About noon Mr. *Sandys* came and bled the patient to the quantity of 18 or 20 ounces: He continued reſtleſs all this night. Upon Mr. *Sandy*'s aſking the patient, whether his

his averſion to drinking proceeded from any pain in ſwallowing, or ſome other cauſe? He made anſwer it was from a pain in ſwallowing.

Next morning the patient's ſtrength not being at all diminiſh'd, and his pulſe continuing full as vigorous as ever, Mr. *Sandys* bled him again to the quantity of 15 or 16 ounces; yet he ſtill continued the ſame, and took the ſame care of his horſes as uſual. Mr. *Sandys* going away left orders, that as long as the following ſymptoms, *viz.* reſtleſſneſs, ſtrength, and averſion to drinking continued, the patient ſhould be blooded freely, and put into the cold bath.

He was blooded twice more within the week; ſo that the whole quantity he loſt in that time was about 120 ounces.

After the laſt bleeding his ſymptoms diſappear'd, and he grew weak, low ſpirited and ſleepy: Then he went 8 times into the cold bath. He did not take any medicines during his whole ilneſs.

N. B. This perſon continued well ever ſince, Anno 1738.

New Experiments on Ice by the Abbé Nolet, Phil. Tranſ. Nº 449. p. 307.

1. ICE, that begins to melt, and water, that begins to freeze, have always the ſame degree of cold.

2. That cold may be increaſed by a mixture of ſalts.

3. It has been thought for a long time that ſaltpetre was the fitteſt to heighten the cold of ice, but experiments have ſhewn, that few ſalts do it ſo little as that ſalt. Mix one part of fine ſaltpetre with two parts of pounded ice, and M. *Reaumur*'s thermometer will deſcend in it but 3 degrees and ½ below the freezing point:

What had caus'd this miſtake is, that people generally made uſe of ſalt-petre of the firſt or ſecond melting, as being the cheapeſt: But, that ſalt-petre not being purified contains a great deal of ſea ſalt; and it was in proportion to the quantity of ſea-ſalt, that the effect was the greater.

From this laſt obſervation one may deduce an advantageous method for trying gun-powder. For, as of the three ingredients of which it is made up, ſaltpetre is the only one that can increaſe the cold of ice; if one part of gun-powder, or a little more, be mixt with two parts of ice, and it increaſes its cold more than three degrees and a half, it is a ſign that the ſaltpetre contain'd in it is not well purified: And the beſt gun-powder is that which does leaſt increaſe the cold of ice.

4. Sea-ſalt, that is, the bay ſalt, which is commonly uſed at table

table in *France*; and that which is immediately taken from the mines, call'd *ſal gemmæ*, do, for the moſt part, give the greateſt degree of cold: For, pot-aſh ſometimes gives a little more, but generally leſs. Sea-ſalt mixt with ice in the aforeſaid proportion gives 15 degrees of cold on M. *Reaumur*'s thermometer, and *ſalgemmæ* 17.

5	Aſhes of green wood	3 degrees
6	ſea-coal	2
7	vitriol	2
8	tartar	10
9	common pot-aſh (in *France*, call'd *ſoude ordinaire*.)	3
10	Pot-aſh made of *vreck* or ſea-weed	11

This laſt pot-aſh may be ſubſtituted inſtead of ſea-ſalt, for making ice-creams, in places where ſalt is dear, as in *France*, where it is ſold for 10 ſols a pound.

1ſt. Becauſe in *France* this pot-aſh is ſold only for two ſols and a half a pound.

2dly. Becauſe, not freezing ſo faſt, it does not ſpoil the creams, by reducing them to iſicles.

3dly. Becauſe ice creams, made this way, will keep longer in a condition fit to ſerve at table.

11. Sugar gives	4 degrees
12. Allom	1 $\frac{1}{2}$
13. Salt of glaſs	10
14. *Sal ammoniac*	12 $\frac{2}{3}$
15. Quick-lime	1 $\frac{1}{4}$
16. *Sal Glauberi*	2

17. The cold of ice may ſtill be conſiderably increaſed by a mixture of ſpirit of wine; about a drinking-glaſs full of it to a pound of beaten ice.

18. The cold of ice will not increaſe, unleſs the ice melt.

Experiments. Put into one veſſel four ounces of ice pounded very ſmall, and into another veſſel two ounces of ſea-ſalt; ſet the two veſſels in a mixture of ice and ſalt, which is ſtill to be renew'd, till, by means of the thermometer, you find, that the ſalt and the ice of the two firſt veſſels have acquir'd each of them ten or twelve degrees of cold; then mix your ſalt with your ice, and this mixture will not increaſe the degree of cold the ingredients had acquir'd, becauſe the mixture does not melt.

But if, instead of salt, you mix with your ice spirit of nitre, cool'd to the same degree as the ice; as this last is liquid, it will melt the ice, and considerably increase its degree of cold.

19. Salt, mixt with water, increases its degree of cold.

20. Of all salts, *sal ammoniac* gives the greatest degree of cold: So that if that salt has been cool'd in ice; and then one part of it be thrown into two parts of water, cool'd to the same degree in ice, that water will become colder than ice, and will freeze other water thrown into it in a small quantity.

This last observation may be applied to the cooling of liquors, where no ice is to be had: For, there is hardly any place, but what has wells; now the water of a well moderately deep wants about eight or ten degrees of the cold of ice; and *sal ammoniac*, being cool'd beforehand in the well, will, by mixing with some of the water of that well, come very near to the cold of ice.

An Observation of the Magnetic Needle, *being so affected by great Cold, as not to traverse, by Capt.* Christopher Middleton. Phil. Transf. N° 449. p. 310.

IN *Phil. Transf.* N° 418. Captain *Middleton* made mention of a strange phenomenon, relating to the sea-compass, which he had frequently observ'd, when among the ice in *Hudson's Bay*; to wit, that the magnetic virtue of the needle was so far lost or destroy'd, that it would not traverse as usual, even when the ship was in a considerable motion: And in his voyage thither in 1737, he observ'd that the compass would not move at all, any longer than the quarter-master kept touching it.

There was then much snow on the land, and several isles of ice round them, and the sea not very smooth. The Captain ordered one of the compasses to be brought into the cabin; but he did not find it any better, till it had stood near the fire about a quarter of an hour; and then it began to traverse very well. He then order'd it to be placed in the binnacle, and another to be brought into the cabin; changing them alternately thus every half hour; and he found by this means he could make them traverse, as well as in any other part of the world. He was obliged to continue this practice, 'till they got near 100 leagues from the coast, but afterwards he had no occasion for that trouble.

What should be the cause of this surprising phenomenon, he cannot conjecture; being certain that the compasses, as to their mechanical structure, were very perfect, and answer'd very well both before and after, during the whole voyage. There is never

any

any oil used to make them move easily: For, in that case it might often congeal, and stop the motion of the chard. But whether the cold of the climate hath a power to deprive the needle of its virtue for a time; or that the friction is thereby increased to such a degree, as that it cannot be overcome by the magnetism, he could not say; but the fact is certain and surprising.

An uncommon Palsey *of the* Eye-lids; *by Dr.* Andrew Cantwel. Phil. Transf. N° 449. p. 311.

A Nun about 30 years of age was troubled with as singular a disorder as the Dr. ever heard of; *viz.* an intermitting periodical palsey of the eye-lids, which began every evening about 6 o'clock, with a defluxion from the great *canthus* of a whitish matter of some consistence: So that she continued blind till next morning, and then recover'd the use of her eye-lids, as before.

This disorder held her for four months; from which time all remedies order'd her by her physician proving ineffectual, she was sent to *Balleruc* for the benefit of the waters.

The Dr. had a fair opportunity (as the patient and he lodged at the same house) of observing the effects the waters had on her. She was pump'd on the back part of her head and neck seven times, without receiving any sensible benefit: The ninth time her disorder seised her an hour later than usual, and the defluxion became less and thinner. The next evening it became two hours later, and the following night she had as much command of her eye-lids as ever. She took the *douche* (for, so they call this way of pumping) the next morning and evening, and was entirely cured.

The Dr. sat with her an hour that evening, carefully observ'd her eye-lids by candle light, and ask'd her several questions on her disorder. She open'd her eyes as well as the Dr. did his, and set out next day for *Montpelier*.

An Account of a Man *whose Arm with the Shoulder-blade was torn off by a* Mill, *on the* 15. *of* Aug. 1737; *by Mr.* John Belchier. Phil. Transf. N° 449. p. 313.

ONE *Samuel Wood*, about 26 years of age, being at work in one of the mills near the *isle of Dogs* over against *Deptford*, and going to fetch a sack of corn from the further part of the mill, in order to convey it up into the hopper, care-

lessly took with him a rope, at the end of which was a slip knot, which he had put round his wrist; and passing by one of the large wheels, the cogs of it caught hold of the rope, and he not being able to disengage his hand instantly, was drawn towards the wheel, and rais'd off the ground, till his body being check'd by the beam which supports the axis of the wheel, his arm with the shoulder-blade was separated from it.

At the time the accident happen'd, he says, he was not sensible of any pain, but only felt a tingling about the wound, and being a good deal surprised, did not know that his arm was torn off, till he saw it in the wheel: When he was a little recover'd, he came down a narrow ladder to the first floor of the mill, where his brother was, who seeing his condition ran down stairs immediately out of the mill to a house adjacent to the next mill, which is about 100 yards distant from the place where the accident happen'd, and alarm'd the inhabitants: But before they could get out of the house to his assistance, he had walked by himself to within about 10 yards of the house; where being quite spent by the great effusion of blood, he fainted away and lay on the ground: They immediately took him up, and carried him into the house, and strew'd a large quantity of loaf-sugar powder'd into the wound, in order to stop the hemorrhage, till they could have the assistance of a surgeon, whom they sent instantly for to *Limehouse*; who brought with him an *apparatus* for a broken arm, which he understood by what he could learn from the messenger to be the case: However, he sent home for proper dressings, and when he came to examine particularly into the wound, in order to secure the large blood-vessels, there was not the least appearance of any, nor any effusion of blood: So having first brought the fleshy parts of the wound as near together as he could, by means of a needle and ligature, he dress'd him up with a warm digestive, and applied a proper bandage. The next morning he open'd the wound again, in company with two surgeons more; and not perceiving any effusion of blood at that time, he dress'd him as before, and sent him in the afternoon to St. *Thomas's Hospital*, where he was admitted a patient under the care of Mr. *Ferne*, from which time he was constantly attended, in expectation of a hemorrhage from the subclavian artery: But there being no appearance of fresh bleeding, it was not thought proper to remove the dressing during the space of four days, when Mr. *Ferne* open'd the wound; at which time likewise

there

there was not the leaſt appearance of any blood-veſſels: So he dreſs'd him up again, and in about two months time the cure was entirely completed.

Upon examining the arm within a day or two after it was ſeparated from the body, Mr. *Belchier* found the *ſcapula* fractur'd tranſverſely, as were likewiſe the *radius* and *ulna* in two places: But whether theſe bones were fractured before the arm was torn off, the man could not poſſibly judge.

The muſcles inſerted into the *ſcapula* were broke off near their inſertions, but the muſcles ariſing from the *ſcapula* came away with it entire.

The *latiſſimus dorſi* and *pectoralis* were likewiſe broke off near their inſertions into the *os humeri*.

The integuments of the *ſcapula* and upper part of the arm were left on the body, as alſo the clavicle.

But what is very ſurpriſing is, that the ſubclavian artery, which could never be got at to be ſecured by art, ſhould not bleed at all after the firſt dreſſing; the artery being ſeparated ſo happily, that when its coats were contracted, the fleſhy parts preſs'd againſt its mouth, and prevented any effuſion of blood.

A Bullet *lodged near the Gullet for almoſt a Year; by* George Lord Carpenter. Phil. Tranſ. N° *449*. p. *316*.

THE late Lord *Carpenter* was wounded, at the defence of the breach of *Bribuega* in *Spain*, in the mouth, by a ſmall muſket-ball, which, having taken away part of his upper lip, beat out all his teeth, excepting two, on one ſide; broke and ſplinter'd part of his upper jaw-bone, went thro' his tongue, and lodged itſelf near his gullet, where it remain'd fifty one weeks and three days, before it was extracted.

The ledge which was made upon the bullet by the two foreteeth, lying almoſt by the gullet, and continually grating upon it, occaſioned an intolerable pain, and hindering him from ſwallowing any thing but liquids, it brought him ſo low, that his life being deſpair'd of, to make a final trial, his tongue was drawn out as far as poſſible; and one of the ſurgeons feeling the ball with his probe, which he then took to be a piece of a tooth (ſeveral pieces of teeth having been beat into his tongue by the bullet) and endeavouring to extract it, he took hold of the ledge with his forceps, and pull'd the ball out, after which he recover'd in a few weeks.

The marks of the foreteeth were to be ſeen on the bullet, and where it flatted upon the jaw-bone.

There

There is an extraordinary account of a gun-shot wound in *Phil. Transf.* N° 320, being the case of one Dr. *Fielding* who was shot in near the eye; and after 29 years the bullet was cut out near the *pomum Adami*.

An obstruction of the Biliary Ducts, *and an Imposthumation of the Gall-bladder, discharging upwards of* 18 *Quarts of* Bilious Matter *in* 25 *Days, without any apparent defect in the Animal Functions; by Mr.* Claudius Amyand. Phil. Transf. N° 449. p. 317.

ONE Mr. *Le Grange*, about 50 years of age, of a sallow bilious complexion, died of an abscess in the gall-bladder.

Dr. *Vatas* his physician in ordinary says, that about 14 years before, this Gentleman was afflicted with a tertian ague, which was cured by the bark; and from that time had complained of a sense of weight, and some uneasiness and hardness in the region of the liver and *borborygmi*, which were reliev'd by frequent purgations; notwithstanding which, he had enjoy'd all the appearances of health, till about four months before his death, when some symptoms of the jaundice first began to appear on him, which had greatly increased five or six weeks before he died, when he began to complain of shooting pains on the right *hypochondrium*; which was soon follow'd with a hard inflammatory tumour there, tending to suppuration.

May 4. Mr. *Amyand* met Dr. *Vatas* and Mr. *Fiquel* his surgeon, in order to open a large abscess pointing below the cartilages of the second and third spurious ribs on the right side. It was determin'd to open it immediately with a lancet, whereupon a pint of a purulent fetid matter was discharged. The aperture being large, and the dressings easy, by the next day it was found, that a very large quantity of *sanies*, and some *pus* left in the bag, had found a vent; and this was so great, that it was thought proper to renew the dressings twice a day.

This had the desir'd effect so far, that from this time the matter decreased daily till the 12th of *May*, when during the night, the wound had discharged near two quarts of matter of a saffron colour, intermixt with large flakes and thick lumps of a coagulated lymph or jelly, tinged of a deep yellow; and what surprised no less was, that upon dressing, way was made for the discharge of about a quart more of the same, as the orifice of the bursted bag was enlarged, to favour the coming out of the large flakes and lumps of jelly, obturating at times this orifice:

During

During this day the discharge was very great, and at night about a pint more of the same matter was emptied: From this time a short and thick *cannula* was left in the opening of the bursted bag, this causing a more easy and constant discharge; and a vulnerary injection, strongly saturated with spirit of wine, had the good effect to diminish it very considerably; but yet it continued so very great, that there was just reason to apprehend the patient would soon sink under so great a flux of this bilious matter, and the rather as his stomach and rest failed him; but the discharge daily lessening, and his appetite and rest returning in proportion, he recovered strength enough to be able to walk: All this while the appearances of the jaundice were wearing off, the urine was returned to its natural colour, and the patient had regularly a natural stool every day, till about 8 days before his death; when his body becoming costive, the physician found it necessary to discharge the *fæces* by clysters and lenient purges: Whilst Mr. *Amyand* attended him, his belly was always free from fullness or tension, being soft and lank, and he less troubled with wind, than he had been for many years before: Two days before he died, he went to air himself in another room and caught cold: This is presumed to have occasioned a fever, followed with a lethargy, in which he continued till the 29th of *May*, when he died.

Upon dissection, it was observed that the patient was not near so extenuated, as might have been expected, after so great a discharge of bile and lymph for 25 days; for, much fat was still observed under the skin and elsewhere, and his flesh not much sunk from the natural state, but the blood-vessels were found extremely empty: In the *abdomen* the caul or *omentum* was shrivel'd up, and adher'd to a great bag or *cystis*, affixed to the inside of the great lobe of the liver, and stretching from thence along the right flank, over one half of the kidney on that side: The left lobe of the liver was removed from the left side to the right, not reaching farther than the right edge of the *Cartilago ensiformis*, and the *pylorus*: The *ligamentum latum suspensorium hepatis* was drawn backwards into the right *hypochondrium*: The liver was of a natural colour, but very small, and more decayed and wasted in proportion than the other *viscera*, but as free as they from any preternatural adhesion, obstruction or induration; and the bag or *cystis*, arising from it, strongly adhering by its outside only, to the *peritonæum*, down to the right kidney.

Upon

Upon paſſing the finger thro' the wound in the integuments, it entered firſt into a cavity made between the *peritonæum* and the outſide of the *cyſtis*, in which the matter of the *abſceſs* had been lodged, and then thro' a hole in the *cyſtis*, or grand bag thro' which the great collection of bile in this *ſaccus* had afterwards made its way; and it was obſerved that the ſtrong coalition of this bag to the *peritonæum*, round that part where the *pus* had been collected, had ſhut up all communication with the cavity of the belly, and thereby prevented any extravaſation into the *abdomen*.

Now the bag or *cyſtis* being ſeparated from the *peritonæum*, and this and the liver ſpread on a board, it was obſerved that the matter had been collected in the gall-bladder, without affecting the liver itſelf: The *veſica fellis* was become a very large bladder, and extended ſo as then to appear capable of containing three pints, or more; it was nearly as broad as long; it aroſe very broad from the inner ſurface of the right lobe of the liver, which it occupied about 10 inches in circumference or more; its bulk had removed the ſtomach and *pylorus* from their natural ſituation, and preſſed them far under the left hypochonder, and that part of the *colon* placed naturally on the right kidney, forwards upon the ſpine; its ſurfaces were rugged and unequal, as that of a *potato*, and its coats thick and horny, forming ſeveral tumours, elongations or expanſions, of different ſizes and figures; one of which, as large as a hen's egg, was full of a cretaceous matter, intermixt with hard white ſtones: This cretaceous bag was made in the duplicature of the gall-bladder, but had no communication with, nor opening into it, which, ſeveral other tumours appearing of the ſame kind, had: Whence it was preſumed that ſome very ſmall pieces of cretaceous matter, found in the great bag, might have dropt from them into it, but it is more likely we had dropt them there, becauſe nothing like them had been diſcharged thorough the wound. The outward opening in this bag anſwer'd in the cavity of the *abſceſs*, wherein inciſion had been made, as this latter was formed between it and the *peritonæum*. In the bag were found about two ounces of the ſame bilious matter, which had all along been diſcharged; which being computed muſt be equal to, if not exceed the quantity of 18 or 20 quarts, during the 25 days the patient liv'd, from and after the opening of the tumour.

It has been obſerved, that the liver was in a natural ſtate, and that the matter collected in the gall-bladder had not in the

leaſt

least wounded or affected the liver itself: So that the large quantity of bile and lymph daily discharged thro' the incision, must have proceeded from the internal surface of the distended gall-bladder.

This put them upon enquiring for the *radices cysticæ* and the hepati-cystic ducts, namely, those very ducts which *Giovanni Caldesi* has so carefully traced in several animals, and delineated in his *Observationi Anatomiche al illustrissimo S. Francisco Redi*, 1687. and which *Verheyen* has discover'd in the bullock kind, but could not trace in human subjects; namely these ducts whereby so great a quantity of gall has been deposited in the gall-bladder; for as much as the *ductus cysticus* was obturated, whereby some anatomists have supposed the gall to flow back from the hepatic ducts: And upon dissection, was traced a trunk like that, which *Bidlow* and *Winslow* observ'd in man, and like that formed by several branches in the liver, and discharging itself into the gall-bladder.

The *ductus communis choledochus* was found empty, and opening, as usual, into the cavity of the *duodenum*; but the *cystic* duct was compressed by the bag in such manner, that nothing could pass thro' it.

The *spleen*, *pancreas*, and all the other *viscera*, were in a natural state, saving (as hath been already observ'd) that some of them had changed their natural situations.

Upon the whole it appears, 1. That the animal functions have been noways vitiated by some of the *viscera* having been displaced; and notwithstanding that for 25 days the discharge of the bile thro' the wound had been so great, that little was left to pass into the *duodenum*, nevertheless he digested his food well. The stools continued regular, till within a few days before he died; and even to the last the *fæces* all along retain'd their natural colour.

2. It may be observ'd, that the jaundice in this patient was not occasioned by the obstruction in the *cystic* duct, tho' that is imagined as a common cause of this malady: For, this obstruction must have been of many years standing, and this patient's jaundice was of a very late date. Nor was his jaundice owing to any retention of the bile in the *porus biliarius*, from the tumour continually pressing that duct, and thereby obstructing the free discharge of the bile from the glands of the liver into the *duodenum* and gall-bladder; nor even to the strong compression and total obstruction of some, yea almost all the biliary ducts, *viz.* the *pori biliarii*, the *ductus hepaticus*, the *hepati-*

cystici, and the *ductus cysticus* and *communis choledochus*; the principal of which are seated in the cavity of the great lobe of the liver, under the pressure of this great and hard tumour, and under its increase for near 14 years together, obstructions and compressions generally accounted as primary and idiopathic causes of the jaundice; because no distemper like the jaundice had appear'd in this patient till a few months before his death; and no true jaundice till within a few weeks, and only then as the *abscess* formed in the neighbourhood of the liver had brought an inflammation there: But as all the symptoms of his jaundice began to wear off, soon after the *pus* had got a vent, *viz.* as the inflammation of the liver, brought on occasionally by a suppuration in the neighbouring parts, wore off, and some days before the bursting of the gall-bladder, it does not appear unlikely, this inflammation of the liver was the pathognomonic cause of the jaundice here; which inflammation of the liver, as it was accidental; so the jaundice occasion'd thereby was actually removed soon after a vent was made for the purulent matter, which had occasion'd this inflammation.

N. B. The figures refered to were done by memory.

A (Fig. 2. Plate XII.) represents the external surface of the right lobe of the liver.

B. B. Parts of the same.

C. C. The ligament which suspends the liver to the diaphragm.

D. D. The ligament which suspends it to the *cartilago ensiformis*.

E. Part of the gall-bladder below the liver in its fore-part, emptied of its contents, arising from the cavity of the right lobe, 10 to 12 inches in circumference.

F. F. F. F. Its adhesions to the *peritonæum*.

G. An opening into the external bag or *abscess*, or incision into it.

H. H. H. H. H. Elongations and inequalities in it.

O. O. O. O. The angles of the *cystis* open'd, shewing in its back parts an elongation opening into it at P.

A. A. A. (Fig. 3.) represents the concave side of the liver.

B. The umbilical vein.

C. The *vesica biliaria* emptied; which when full cover'd almost all the inside of the right lobe on its back part.

D. D. D. D. D. D. Several elongations or expansions of the *vesica* opening into the gall-bladder.

E

E. The cretaceous bag in its duplicature full of a chalky matter, intermixt with hard white irregular ſtones,

Some Obſervations on the above-mention'd Caſe; by Dr. Alexander Stuart. Phil. Tranſ. N° 449. p. 325.

THE Dr. points out what appears to him to be the mechanical and neceſſary connexion between the apparent cauſes and the effects in this uncommon caſe.

1. As to the original or prime cauſe of all the ſymptoms, to wit, the diſtention of the gall-bladder, now become a morbid *cyſtis* of an enormous ſize.

If we conſider the ſize and figure of the liver, the ſituation of the gall-bladder, with the courſe or direction of the biliary veſſels, from various places of the liver, towards that narrow ſpace where the *pori biliarii* open into the *cyſtis*, it will appear, that in almoſt every poſition of the body, at leaſt in an erect, ſupine and lateral poſition, ſome of theſe biliary ducts, terminating in the gall-bladder, are perpendicular or nearly perpendicular to the horizon and to the *cyſtis:* Therefore, as far as gravity takes place in the animal oeconomy, the bile deſcending by theſe ducts, will preſs upon the contents of the full *cyſtis* and its ſides, as a cylinder of that fluid, of the length of the ſecretory ducts or tubes, and of the diameter of the *cyſtis.*

Beſides this, the extremity of every one of theſe ſmall ducts conveys its fluid into the full *cyſtis*, as a wedge acted upon by the repeated ſtrokes, impulſes or preſſure of the circulating blood of the *vena porta*, where it ſupplies the gland at the origin of each ſecretory duct.

Therefore, by the known laws of hydroſtatics and mechanics, it is plain, that the force of this ſecretion of the bile into the gall-bladder is very great, and the quantity thereof conſiderable; ſufficient at leaſt to diſtend the *cyſtis* to an enormous pitch, where the diſcharge by the *ductus cyſticus* is not equal to the ſecretion by the *pori biliarii*, and the *ductus hepatico-cyſticus.*

Theſe ſaid powers do ſufficiently account for the diſtention of the *abdomen* in an *aſcites*, of the womb in geſtation, of the bladder in a morbid or voluntary retention of urine; as alſo of morbid impoſtems or tumours, and of the gall-bladder in the caſe before us.

But this diſtention could never have happened, without a total or partial obſtruction of the excretory duct, namely the *ductus cyſticus.*

Had this obstruction been at once total, as when a *calculus* is thrown suddenly out of the *cystis* into the duct, and stops it entirely, he must have had the jaundice immediately, or very soon after: For, notwithstanding the strong powers above-mentioned, it would have been impossible for the sides of the *cystis* to have yielded to such a sudden dilatation, no more than the womb in the first week of gestation can be dilated to the pitch it is brought to in the ninth month, without a rupture: So that the dilatation here must have been very slow and gradual; and therefore the obstruction must have been at first, and probably for several years, only partial; and the gall-bladder thus slowly distended, gradually yielded and gave way only for the reception of the excess of the secretion beyond the excretion; and so prevented the jaundice, or regurgitation of the bile into the blood.

This partial obstruction of the *ductus cysticus* may probably have been occasioned by one of those small soft incysted tumours, lodged between the membranes of the *cystis fellea*, near the origin of its excretory duct, containing a soft white pultaceous matter, with *calculus*'s or chalky concretions in its centre.

If this was the case, it is conceivable that while the contents of this small incysted tumour was fluid or soft, it might not be capable to obstruct entirely the current of the bile thro' the excretory duct: But as the matter of it grew thicker, and its bulk increased, by pressing gradually more and more upon the duct, the obstruction must increase; and the formation of *calculus*'s, by their pressure, must at last make the obstruction total,

But as the cystic duct was at opening of the body, entirely coalesced and obliterated, its vicinity and situation, with respect to these small incysted pultaceous and cretaceous tumours, cannot be precisely determined; and therefore this is offer'd only as a probable conjecture.

The bulk, contents and adhesions of the gall-bladder to the right side, were without doubt to the patient a very sensible, and to others a visible cause of his first symptom, *viz.* the increasing weight he felt in the region of the liver, for 14 years before his death.

The current of moving humours in the animal body is always determined most strongly to the place of least resistance: Therefore, by the partial obstruction of the cystic duct, a greater quantity of bile than usual will be forced upon the biliary ducts, leading directly from the liver into the great hepatic duct, to discharge itself by the *choledochus communis* into the *duodenum*, sufficient for the moderate uses of the animal oeconomy; tho'

not so perfectly sufficient, but that the peristaltic motion in the present case felt the want, or at least the defect of the cystic bile; so far as to become weak and imperfect; too weak to propel the *fæces*, or keep the elastic air within due bounds; and therefore the patient must be subject to flatulent distentions, and some degree of costiveness, only to be reliev'd by supplying the want of a sufficient natural *stimulus* of the gall, by the artificial *stimulus* of purgatives and clysters, to assist from time to time the expulsion both of the *fæces* and also of the *flatus*'s, for the ease of the patient, as was practised in this case.

As to the jaundice, it began to shew itself four months before the patient's death, and continued increasing till the external purulent tumour in his side was opened, and then it began to decline, and quite disappear soon after the gall-bladder burst.

It is easy to conceive, that so long as the gall, descending from the *pori biliarii*, could make its way into the *cystis fellea*, and dilate it; there could be no regurgitation of the bile into the blood; and therefore no jaundice.

But so soon as the purulent impostem began to form itself in the neighbourhood and contact of the distended gall-bladder, it encroach'd or press'd upon the *cystis fellea*, by the force of a great many vessels, pouring *pus* into the cavity of the impostem, urged on by the circulation of the blood, which is more forcible in these vessels than in those of the liver.

And therefore this purulent tumour increasing, will very forcibly incroach on the *cystis fellea* in contact with it; and not only hinder its farther distention, but even force the gall it contains to regurgitate or return again by the *pori biliarii* upwards, and from thence by the capillaries of the *cava*, into the blood; and so produce the jaundice, without raising an inflammation or obstruction in the liver itself, whose vessels and passages remain open, tho' the bile take a retrograde course in its biliary secretory ducts.

But so soon as this accessary pressure is taken off from the *cystis fellea*, by opening and emptying the purulent tumour or impostem in its neighbourhood, adjoining and adhering to it, the bile begins again to flow freely into the *cystis fellea*, and dilate it as before: Therefore, the regurgitation of the bile into the blood ceaseth, and the jaundice begins to decline.

Then so soon as the rupture or bursting of the gall-bladder happened, and it began to be emptied; all degrees of resistance being now entirely taken off from the *pori biliarii*, they throw out their contents so plentifully, that the hepatic ducts are gradually

dually frustrated by such a strong revulsion; the bile begins to flow all to the wounded and almost emptied *cystis biliaria*, and either very little or none at all to be carried by the *ductus hepaticus* to the *choledochus communis*, whose diameter and passage into the *duodenum* was found larger than usual, but empty.

In this state, which was the last stage of the distemper, the peristaltic motion begins to fail, the expulsion of the *fœces* to be very tardy, or not at all to answer without the assistance of purging medicines or clysters, which also had but a very slender effect; the patient ceaseth to be nourish'd (tho' he took a competent quantity of food) and dies in a week after this costiveness began.

The degree of perfection of the natural, vital and animal functions in this person, during 14 years indisposition, was certainly owing to the soundness of all the *viscera*; and an almost sufficient secretion and excretion of bile by the *ductus hepaticus* into the *choledochus communis*, whose cavity and passage into the *duodenum* was large and open; which could neither have been, nor have continued, without a continual and proportional flux of bile thro' it.

For, it is well known, that as soon as the fluids cease to flow thro' their natural ducts, their sides soon collapse, coalesce, and at last entirely shut up: Thus the *urachus*, and *canalis arteriosus Botalli* in the *fœtus*, shut up entirely soon after the birth. And the Dr. and Mr. *Amyand* had lately seen one of the *ureters* entirely collapsed and shut up, for want of a fluid from the kidney, which had secreted no urine for some time; having become a *cystis*, fill'd with a thick white pultaceous matter, nearly of a chalky consistence.

Therefore, as the *ductus cysticus* was found obliterated, and the *choledochus communis* large and open, it is plain, that no bile had for some time flow'd thorough the former, and that there was a constant supply from the *ductus hepaticus* to the latter, for the uses of the animal oeconomy, till the wound or rupture of the gall-bladder, gradually abating its current by that channel, at last stopp'd it quite, and put an end to the patient's life in a few days after.

The most essential points in this case, bearing a conformity with what the Dr. observ'd in a former *Transaction*, concerning the use of the bile in the animal oeconomy, may so far serve to confirm it.

An Historico-physical Observation on the Neusohl *Vitriolic Waters, commonly call'd* Cement-Wasser; *by M.* Matthias Belius. Phil. Transf. N° 450. p. 351. *Translated from the* Latin.

THESE springs are a mile to the north of the town of *Neusohl*, in the large copper-mine, call'd *Herren-grund*: The time when they were first discover'd and observed, is uncertain: That they were not known in the days of *George Agricola*, the *German Pliny*, may be concluded from his silence about them.

After the sacking and burning of *Neusohl* in 1605 by *Botskay*, the miners, to save their iron tools, as their hammers, *&c.* and other effects, hid them in the mines; where remaining for upwards of a month, they were found in those moist places cover'd over with a crust of copper, which was the thicker, the damper the place was where they had lain. From thence they therefore concluded, that the waters trickling down along the sides of the mines, must be endued with a quality of producing copper, which at length gave occasion to their making wooden trunks, for collecting these waters, as at *Schmolnitz*, and arching them over.

Now this compendious method of producing copper approved itself so much, that there are upwards of 20 such places; two of which M. *Belius* gives an account of, whereby one may easily judge of the rest.

The principal one is about 75 fathom perpendicular depth; and you descend to it in a winding manner by steps for 151 fathom: The water trickles down in single drops from the sides of the mine, and is received at first into a smaller vessel, and after that into one larger, and divided into trunks. Into the lesser are put the smaller pieces of iron, as horse-shoes and the like, which in three or four weeks time are turn'd into copper, of the same form as before, but emboss'd a little: And the water in this, has a much greater virtue than that receiv'd into the larger one: For, in the latter the iron corrodes slowly, and in such manner, that at first only a slimy pellicle, of a yellowish colour, floats upon the surface of the water, which pellicle at length gradually adheres to the iron, when not entirely consumed, like a fat slime, which the miners call *der schmund*; and which every month they carefully take from off the iron, and put in a peculiar high place to drain; and this they repeat till the iron, or the greatest part thereof, be entirely consumed.

The

The ſecond vault is 15 fathom lower, which from its form and ſituation, is call'd the *long vault*: For, being two fathoms in breadth throughout, it is 25 fathoms in length: In this the vitriolic water trickles more copiouſly than in the reſt of the vaults: For, beſides that it drops down from the ſides and roof of the mine, it has two conſtant ſprings, which continually yield a ſtream of water of the thickneſs of a ſtraw.

Both ſprings riſe from the ſouth; and the firſt is three paces to the left from the entry of the vault, and the ſecond five paces more inwardly: And that the waters may not be waſted, they are conveyed thro' ſmall pipes, partly into wooden trunks and partly into ſquare veſſels, into which at length are put old and new iron.

M. *Belius* obſerved that the trunks for receiving the water and the iron, are ſo carefully diſpoſed on the ground, that none of the water can be loſt: For what is receiv'd into one trunk, flows into another, and from this into a third, and ſo on; yet the efficacy of the waters is much diminiſh'd: For, in the firſt, the iron is conſumed ſooner and more ſtrongly; but ſlower and more weakly in the ſecond and third.

In this vault, from a middle wall, there trickles down a peculiar and more limpid ſort of water, which is therefore receiv'd into a peculiar veſſel: And into this the copper, made in the other vaults, is at length put, if they want to have it purer: For, this limpid water has the quality of rendering impure copper more fine and bright: Beſides the above receptacles for the vitriolic waters, there are up and down in the windings of the mines, damp places, where iron is tinged of a copper colour, which ſhews that all their moiſture is vitriolic.

As to the water itſelf, it appears greeniſh in the veſſels or reſervoirs; tho', in a clear glaſs, it be limpid, and tranſparent like cryſtal; it is inodorous, but of a vitriolic aſtringent taſte, and of a cold nature. M. *Belius* unwarily taſting a few drops of the water at the ſprings, had his lips ſhrivel'd up in ſuch manner, as thoſe, who are juſt recover'd from a fever. After having crept thro' theſe ſubterraneous paſſages for three or four *German* miles, he felt no pain in his lips, but a gentle kind of itching; but upon coming into the open air, they began at firſt to ſwell, and afterwards to ſuppurate: In other reſpects the water has the ſame efficacy, only where it happens to trickle down more copiouſly: For then it is more dilute, and ſlower in conſuming iron.

The

The water is so far from spoiling the wooden trunks and reservoirs, that receive it, that it hardens and makes them last longer than usual.

The vaults, in which the vessels are included, have no strong smell, nor any vitriol, which shoots every where else in this mine; and this M. *Belius* takes to be owing to the moister air, which dissolves it, and does not suffer it to coalesce into filaments or crystals: Yet in some vaults, where these waters trickle down, one shall find a whitish stone in one place, and quite bluish, like vitriol, in another: And likewise at the sides of the drifts, next the bottom of the vaults, there is a concretion of a kind of mean salt, which, mixt with a moist and yellow earth, is insipid, and friable like *lapis specularis*.

The miners, in desperate cases, do with great hopes of success, drink this vitriolic water as a medicinal potion, which at length causes either a purging or a vomiting, or both at the same time.

The use of it is safer in *ophthalmia*'s, if it be cautiously applied in the manner of a *collyrium*: 'For, vitriolic waters do 'service to the eyes', as *Agricola* says *lib.* II. *p. m.* 117. *de natura eorum quæ effluunt ex terra*.

The copper, which these vitriolic waters generate, is much finer, more ductile, and apter to smelt and fuse than the other kinds of copper; whereby goldsmiths have been induced to make bowls, drinking cups, and tobacco boxes of it.

While this copper remains in the waters, it is much more friable than when taken out of them: For then it hardens in some measure, by a closer concretion of its constituent particles.

The abovementioned slime is no other than indigested copper, precipitated from the water, and sticking to the iron; which is yearly carried to the copper-forge at *Neusohl*, and there refined into the purest copper, and that without any waste; by reason that the iron which is consumed by the vitriolic water leaves behind it a little heterogenous matter in the said slime.

Before these vitriolic veins of water were spoil'd by an inundation that happened within M. *Belius*'s memory, it is certain, a greater quantity of copper was produced from iron: For, in 1707 eighty eight centners of iron were turned into copper; whereas now scarce 20 centners a year.

Whence we may easily conclude, that that inundation greatly impair'd the pristine efficacy of the vitriolic waters; the veins, becoming more copious, entirely weakened the vitriolic spirit,

 which

which they carried along with them; and the few vitriolic vaults, there formerly were, produced more copper, than 20 vaults now; because most of them do not produce solid copper, but slime only, which, as has been said, must at length be refined in a strong fire.

Thus far as to the disposition of these vitriolic waters: M. *Belius* comes now to give an account of the experiments he himself and his friends made to find out their more intimate nature.

Ex. 1. A pound of the strongest vitriolic water, gradually and slowly evaporated, was at first turbid, depositing a little dirty powder, which, afterwards boil'd to dryness, left behind it two scruples and a half of a greenish remainder; this remainder dissolv'd in water, in the usual manner, yielded a green solution; which at length filtred and evaporated, gave two scruples of crystals of vitriol. What remain'd of the powder was of a dirty colour, and weigh'd six grains: So that a pound (apothecary weight) of the vitriolic water scarce holds above two scruples of vitriol of copper.

Ex. 2. A pound of the same vitriolic water, precipitated with oil of tartar, became turbid and of a sea-green colour; this, at length filtred, left a remainder in the strainer; which dried, yielded two scruples and a half, with a little mean salt.

Ex. 3. In fine, a pound of vitriolic water in a glass accurately stopped, began to tinge insensibly of a copper colour, an iron wedge that had been put into it, with bubbles adhering to it here and there; the following day, the water became turbid and whitish, with whitish streaks observable at the same time at the bottom of the glass, and about the wedge: And some days after, a dirty or copperish sediment was observ'd on the same wedge.

From these experiments we learn.

1. That this water is really vitriolic, and plentifully saturated with vitriol of copper, and flows from metallic veins, in which the vitriolic pyrites is dissolv'd.

2. That the same water corrodes and dissolves iron, and precipitates its copperish particles; which insensibly put on the form of the iron, put into it, and to which they adhere; and this a more accurate inspection of this copper abundantly shews: For, it is not formed into a solid and smooth mass, but consists of a vast number of little grains, which coalesce into one friable body, like the spawn of fish.

And indeed it is a thing well known both to chemists and metallurgists, and even to such as are but moderately acquainted with

with these arts, that one metal is precipitated by another: For, quicksilver, dissolv'd in *aqua fortis*, precipitates silver; silver lead; lead copper; and in fine, copper iron.

Hence, upon dissolving a bit of copper in *aqua fortis*, and afterwards putting into it a bit of iron, the same transmutation may be observ'd therein, as in the vitriolic waters; namely that *menstruum* will corrode and dissolve the iron, and at the same time the copper, mixt with the *menstruum*, will be separated from it, and subside insensibly and slowly into the place of the iron.

Since these things are really so; we may hence refute the conclusions, rashly drawn by some from the effects of this vitriolic water.

And 1. Since an equal bulk of copper is usually got from this water, with the iron put into it; such argue wrong who think, that the iron, corroded by the water, deposites the copper particles it contain'd, as loosened from their tye, and entirely consumes the remaining material parts, or cause them vanish.

2. Nor can the essential transmutation of iron into copper take place in this whole operation of nature; which alchemists and other pretended artists persuade themselves, and others; as if a more imperfect and ignoble metal could be entirely changed into one more perfect and noble: For, it sufficiently appears from the above-mentioned experiments, and from physics, that the aforesaid vitriolic water does not transform iron into copper, but only deposite its copper particles, with which it was before impregnated. And M. *Belius* might from his own observation evince the quite contrary to what these pretended artists affirm: For, if iron and copper, metals nearly allied, cannot, by the help of nature itself, be transformed into one another, as, for instaace, iron become copper, much less can that be expected from art, even advanced to the greatest pitch.

That among all the metals, copper and iron, are peculiarly allied to each other, M. *Henckel* has abundantly made out in *hist. pyritum.* p. 424. where at the same time, p. 422 he affirms that, amongst so many experiments, he did not meet with any stone, or copper ore, which the magnet would not attract: So that the attractive virtue of the magnet next to iron, is observ'd to affect copper: And since iron and copper are metals that equally yield what is properly call'd vitriol; a thing which cannot be said of the other metals under the same species and

form: For, they are of a like ſubſtance and colour, either green or blue; and were the pretended hermaphrodite vitriol found any where, it muſt neceſſarily be diſcover'd by infallible ſigns in the preſent operation of nature; and yet this never happens.

Moreover, that the vitriolic waters of *Neuſohl* derive all their virtue and efficacy, as mention'd above, from the vitriolic *pyrites* diſſolv'd in ſubterraneous *meatus*'s, is a thing both ſelf-evident, and confirmed by the works at *Schmolnitz*: For, the whole tract of that town, both on the ſurface and inſide, abounds in a vitriolic *pyrites*: So that the vitriolic water (*cement-waſſer*) ſprings up plentifully not only within the mines, but on their ſurface; whence it happens that it is at the ſame time ſtronger and more efficacious to precipitate copper than the water in *Herren grund*: And the people of *Schmolnitz* are wont, in dry weather, and when the vitriolic waters in the ſprings fail, to water abundantly, with common water from the neighbouring ſprings, the heaps of vitriolic *pyrites* landed from the mines, as alſo the old drifts; ſo that this common water, by elixating the vitriolic *pyrites*, does thereby acquire its virtue of corroding iron, and precipitating copper: Which happens thus; theſe common waters running together into wooden trunks and veſſels do, by elixating the *pyrites*, acquire the ſame virtue and efficacy with the native and vitriolic waters.

A Bubonocele *or rupture in the* Groin, *and the Operation made upon it; by Mr.* Amyand. Phil. Tranſ. N° 450. p. 361.

ON the 8th of *October*, 1737, one Mrs. *Bennet*, 70 years of age, of a thin habit of body, had a return of a tumour in the groin, with unuſual pain, which was ſoon followed with a cruciating one in the belly, and ſuch colics, reachings and excrementitious vomitings, as uſually attend the ſtrangulation of the gut in the *miſerere mei*. This came upon her unawares, and the diſtreſs ſhe was in made her forget that for 25 years before ſhe had had a ſwelling in the groin, as big as a haſel-nut, which ſeldom had given her any uneaſineſs, and which ſhe never ſuſpected to be a rupture. Latterly the patient had been more ſubject to colics than uſual, but that was imputed to bad digeſtions; and that day ſhe had uſed no motion capable of producing a rupture: So that it was by chance that Mr. *Deſpaignol*, who was ſent for the next day, diſcover'd the cauſe of the complaint. She was blooded, clyſter'd, fomented, poulticed and embrocated; but the complaints ſubſiſting

ing with a continual *singultus*, Mr. *Amyand* was call'd in the 11th.

The tumour was now oblong, about the bigness of a hen's egg, somewhat inflamed, yet not tense, nor so painful as to take much notice of it.

Upon the repeated use of the above-mention'd means, and of lenient purges and opiates, the vomitings and hiccough were at times stopped, and the patient made so much easier, as to ground hopes of success; but as during six days the patient had had no passage, and the tumour could not be reduced, it was thought unsafe to delay the operation any longer. At this time she was free from a fever, the belly was not tense, and she had considerable intervals of rest.

The tumour felt unequal, tho' it appear'd even, and pappy, as the tumours of the *omentum* generally are; and therefore of that kind which is always most difficult to reduce, the *omentum* not having that elastic springiness which favours the replacing of the guts.

Upon dissection it was found embodied in the hernial bag, and that upon the external surface of the slits in the abdominal muscles, the folds of it had formed a round protuberance, not unlike the *os tincæ* in the *vagina*, or like a *bourlet*, which, by compressing the gut, prevented its return into the belly, and by obturating the opening, as the gut press'd upon it, had strangulated about an inch of the gut encompast by it in the *hernia*.

This being the 6th day from the beginning of this disorder, the gut in that place was found of a very swarthy colour, but yet springy; so that it was not quite mortified. It lay inclosed in a net, formed by the *omentum*, (like a fish in a fishing net) strangulating the gut under its pressure without the abdominal muscles.

It was with some difficulty the *omentum* was torn off and separated from the bag it was attach'd to; and as this lay in the way of the reduction of the gut, and almost sphacelated; so it was cut off without any previous ligature, tho' its vessels were turgid and large, as it was impossible to pull it out so as to make the ligature upon the sound part of it; after which the reduction of the gut might easily have been made, without enlarging the annular slit: For, this made no stricture to prevent it.

But the quantity of the *omentum* within it being large and bulky, and the gut in a very crazy state, it was thought more expedient to enlarge it, to make the reduction of the whole easy: Afterwards the *omentum* was detach'd from its adhesion round

round this place, and pull'd farther out; and a ligature being made upon the ſound part of it, that was alſo replaced in the belly, and the entrance ſtopt with a conical tent, dipt in the yolk of an egg and oil of St. *John's wort*; the belly was embrocated, and the dreſſings well ſecured: For, as the patient was very much oppreſſed with an aſthma; ſo ſhe was obliged to be ſitting in bed.

From this time the hiccough and excrementitious vomitings diſappear'd, but the reachings and vomitings continued near five days longer, before the *fæces*, detain'd above the ſtrangulated gut, could make their way downwards, tho' they were frequently invited by clyſters and lenient purges.

The patient was blooded immediately after the operation; and ſoon after took an emollient and carminative clyſter, which was repeated night and morning; and an oily laxative of two drachms of *manna*, and half an ounce of oil of ſweet almonds, in mint and ſmall cinnamon-water, every four hours.

At firſt the evacuations were exceeding fetid, black, griping and frequent; but they became more moderate, as ſhe took abſorbents and diluents; but yet ſo frequent, that it was thought proper to reſtrain them by gentle aſtringents; ſo that ſhe might be enabled to bear them.

In five or ſix days the ſtools had remov'd the tenſion, which appear'd on the belly after the operations; the reachings and vomitings, and the remaining ſymptoms went off; the wound digeſted well, and the patient continued in a mending way.

It has been already obſerv'd, that this old woman was very much afflicted with an aſthma: She had at times violent fits of it; and the 14th day from the operation ſhe had one, with a total ſtoppage of the diſcharge from her lungs, which choak'd her on the 17th day.

This caſe confirms Mr. *Amyand* in what he has frequently obſerved on the like occaſion; namely, that as the *omentum* is the principal obſtacle to the reduction of the guts in ruptures; ſo it is the occaſion of the greateſt accidents that attend that evil. It wraps up and encloſes the prolapſed gut, like a net, whoſe faſten'd end within the belly ſtrangulates the part detain'd in the rupture without the abdominal apertures, where it is confined; and is productive of ſuch folds in it, and preſſures of the gut wrapt up therein, as is oftener the cauſe of a ſtrangulation and *miſerere mei* than the tendinous ſlits of the external oblique muſcles in the inguinal rupture, or tendinous opening in the navel; which upon theſe is ſeldom found inflamed,

and

and can never contract ſo ſuddenly, as to obſtruct the return of the gut into the *abdomen*, when the *omentum* is wanting: Agreeable to which, it is rare to find any ſtrangulated rupture that is not attended by it.

The fatty ſubſtance of the *omentum* ſubjects it to inflammations, ſuppurations and putrefactions, that contaminate the neighbouring parts. It wants that elaſtic ſpringineſs the guts have, which favour the reduction in ruptures. It frequently ſtays behind when the guts are reduced, and therefore bars the patient not only from the benefit of retentive truſſes he ſtands in need of for his ſecurity, but it directs the gut into the rupture where it lies, the guts being very apt to ſlide down along it; and when it is fixt in the rupture, it too often pulls and draws into it the *cœcum* and *colon* it is attach'd to, and even the ſtomach itſelf, in proportion as the quantity of it in the rupture happens to be more or leſs; and therefore umbilical ruptures are the moſt dangerous of any: For, as the *omentum* lies over the guts, ſo it is always preſt in foremoſt, in the ruptures of this part, which, when large, will likewiſe cauſe an elongation of the bottom of the bladder that way, and a difficulty of urine, in proportion as the *urachus* attach'd there is ſtretch'd forwards towards the navel.

The pain, attending the *prolapſus*, ſoon ſwells the veſſels of the *omentum*, and that will fill up the apertures in the abdominal muſcles, thro' which the *viſcera* are fallen out, prevent their return, and bring on an inflammation: If by plentiful bleeding the veſſels emptied do not facilitate the return of the parts prolapſed, and all the conſequences that are generally obſerv'd upon the like occaſion; and if theſe do not operate ſoon, it is very ſeldom that any thing is got by the application and uſe of all the other means preſcribed.

It is, however, certain, that it is very dangerous to depend too long upon them; and that a ſuſpenſion of the ſymptoms is no ſecurity, whilſt the due courſe of the *fæces* is interrupted.

The caſe here mentioned may be a warning to others, not to delay too long an operation, whereby the parts are to be releaſed from confinement; and which oftener would be ſucceſsful, if it was not delay'd ſo long.

In the caſe of a rupture with a *miſerere mei*, ſome deny that excrements and clyſters from the lower guts can aſcend and be diſcharged thorough the mouth, upon a preſumption, that the ſtrangulation which prevents and ſtops the deſcent of a thin fluid downwards, muſt likewiſe prevent the aſcent, and eſpecially

cially of ſuch ſolid ſubſtances as are ſaid to be diſcharged upwards; and the rather that the *valvula coli*, and the *rugæ* or valves of the guts muſt impede the aſcent: But the fact is true; and there is no one converſant in practice but has obſerv'd *fæces* and oily clyſters diſcharged upwards.

If this be allow'd, it will follow, that in the rupture of the guts, there is a paſſage thorough their pipe; and conſequently, that the ſtrangulation muſt be leſs than it is generally aſcertain'd.

The inflammation of the guts inverts (but we do not know how) their periſtaltic action, and the diſcharge of the *fæces*; and that ſo long as that is continued: Inſomuch that this will continue even for ſome days after the reduction of the gut is made.

Parts inflamed and in contact will ſoon ſtick and coaleſce together. Pain is the indicating ſign of inflammation; and an inflammation is an intumefaction of the veſſels in the parts inflamed.

If then pain happen to be an attendant of a rupture, wherein the *omentum* is concerned; and the parts ſo inflamed continue in contact; that is, if the parts prolapſed in a rupture are not ſoon reduced, they will ſwell in the bag, and be knit together; and by filling up the opening, by which they had prolapſed, choak up the paſſage, clog and prevent the returning back, compreſs the guts under the preſſure, and ſtrangulate them more and more, in proportion as their bulk ſhall increaſe ſo long as the fluids can flow into the compreſt canals; in which they at laſt ſtagnate, and upon extravaſation ſuppurate; or the mortification of the parts compreſt enſues.

A Pin *taken out of a Child's Bladder; by Mr.* William Gregory. Phil. Tranſ. N° 450. p. 367.

MR. *Gregory* was call'd to the aſſiſtance of a woman in travail: The *fœtus* preſented in a tranſverſe poſition. He ſoon recovered the feet, and in a few moments delivered the woman.

The *funiculus umbilicalis* was ſo ſhort, that it was with difficulty he could make a ligature upon it, in order to make a ſeparation: He immediately extracted the ſecundine, and meaſur'd the *funiculus*, which was little more than four inches long.

As ſoon as the woman was taken care of, he examin'd the child, which he found to be imperfect in ſeveral parts, there being no *anus*, nor privities to diſtinguiſh of what ſex it was:

Where

Where the *vulva* ſhould be, there was a ſmall perforation (tho' no appearance of *labia*) thorough which the urine always paſs'd away: There was likewiſe a large *hernia umbilicalis*, and a little lower in the *linea alba* was a perforation, into which the *rectum* open'd; and that way the excrements paſs'd during the time the child liv'd, which was almoſt 10 weeks.

Several days before the child died, a gangrene appear'd on the *hernia*, which ſoon paſs'd into the inteſtines, and occaſion'd the child's death. The *hernia*, Mr. *Gregory* thinks, was occaſion'd by the ſhortneſs of the *funiculus*, which did not grow in length proportionable to the *fœtus*; the child was perfect in all other parts.

When the child died, Mr. *Gregory* only inſpected into the *rectum* (which he found as above deſcribed) and into the urinary bladder, which he found very ſmall, and no urine in it: The child was never obſerv'd to make water in a ſtream whilſt it liv'd, which makes him think the *ſphincter veſicæ* was imperfect.

In handling the bladder, he found ſomething ſharp pointing to his finger; he could not diſcover what it was till he ſnip'd off the neck of the bladder: He then took out of the bladder a tough kind of ſubſtance, about the bigneſs of a ſmall fig, in which was a pin with the head on, and very black.

A very extraordinary Calculus *taken out of the Bladder after Death; by the* Marquis de Caumont. Phil. Tranſ. N° 450. p. 369.

FIG. 4. Plate XII. repreſents an uncommon ſtone found in the bladder of a man after death, which the Marquis *de Caumont* had cauſe engrave in his own preſence, exactly conformable to the original.

The ableſt phyſicians and the beſt anatomiſts he conſulted on this ſubject, aſſur'd him they never ſaw any thing of the kind like it.

The engraving, tho' very exact, does not come up to this ſingular work of nature; its ten branches, which ſpread from the centre, have ſome reſemblance with thoſe of certain plants.

It is with him a matter of difficulty to think, that the ſyſtem of juxta-poſition, which is employ'd to explain the ſucceſſive growth of common ſtones or *calculi*, can hold good on this occaſion: He however, ventures not to advance that vegetation has any ſhare therein; tho' the ſhape of the branches of the ſtone, and of the canals or *papillæ*, which ſeem deſtin'd to

convey the nutritious juices, do in some measure favour this hypothesis.

From the account of this stone skilful lithotomists may reap some advantage for perfecting their operations: For, allowing the possibility of *calculi* of a conformation somewhat like this, which they may judge of by knowing the bulk of the stone, they will understand, that in such a case, no other method but that of the high operation can facilitate the extraction of an extraneous body, whose branches cannot fail causing considerable lacerations; unless they found some favourable circumstances; and that the contexture of it were brittle enough to break it before its being extracted.

An Account of the above-mentioned Case; by M. Salien. Phil. Transf. N° 450. p. 371.

ONE *Joseph Vasse*, of *Le Thor*, a small town at a short league's distance from *Lisle* in the County of *Venaissin*, 66 years of age, of a robust constitution, who used to travel about to fairs and markets in the said County, and dealing in corn and cattle, without having ever complain'd of any indisposition, began on the 14. of *February* 1731, to feel in the night time some difficulty of making water, attended with a smarting about the *glans*; which, however, did not hinder him from attending his business as before.

On the 28th of *March* 1732, the said *Vasse* was seised in the night with a true *ischuria*, which cruelly tormented him.

On the 29th in the evening M. *Salien* was sent for to search him and to draw off the urine; he accordingly drew six cups each containing a pint and a quarter: The patient found immediate ease, and continued without pain or fever; so that he thought himself entirely cured: But the night following the pains returned; which made him resolve to come to *Lisle* to be nearer at hand to be sounded. He came on the 30th of *March*, and had his water drawn off regularly every day, morning and evening till the 15th of *April* following, during all which time the patient suffer'd no pains, did not fall away, nor had any symptoms of sickness upon him.

On the 15th of *April* he supped with his usual appetite: But half an hour after supper he was seised with a violent shaking fit, which lasted a full hour; upon which a burning fever ensued, attended with an unquenchable thirst, with a violent head ach and extraordinary restlesness.

In this condition M. *Salien* found the patient about 8 in the evening, being the hour he usually went to sound him. He immediately prepared himself to draw off the patient's water, according to custom, thinking thereby to procure him some ease. Till then the catheter had enter'd without any obstacle; but this time upon pushing it into the bladder, he felt a stone which obstructed its passage. He turned the catheter to the left, and hit upon one of the branches of the stone, as represented in Fig. 4. Plate XII.

In order to know whether there was not another stone, M. *Salien* drew the catheter a little back, turning it to the right, which was done without any difficulty: And having push'd it in again, he met with another branch of the same stone, which he took for a stone different from the former; and concluded then that he had found several stones in the patient's bladder: And that if the bad symptoms, which appear'd, should continue any longer, there was no probability of his recovering.

Accordingly, the hiccough coming upon the patient on the 20th, and the other symptoms not discontinuing, he died on the 28th.

The stone was taken out four hours after his death.

The extraordinary figure of this stone will be of no great use in practical surgery; but it may furnish matter of much reasoning to philosophers, to know how it could be formed in the bladder; and yet not be troublesome to the patient for so long a time; and what had given it so particular a figure and so regular a shape.

M. *Salien*, for his part, questions not but it was suspended in the patient's bladder, where it might be framed by the urine; the dried membranous filaments, which were still perceivable on the extremities of some of the branches, are a new proof of this conjecture. The stone happening afterwards to loosen itself, may have occasioned to the patient all those symptoms that at last befel him, and afterwards death itself.

This opinion may appear extraordinary, to able lithotomists; and he submits it to their better judgment.

Concerning the above-mentioned Stone; *by Sir* Hans Sloane. Phil. Trans. N° 450. p. 374.

THE above-mentioned stone is so singular, that among some hundreds of those in Sir *Hans Sloane*'s possession, he had not any, that came near it.

Once, it is true, he had under his care a Gentleman between 60 and 70 years of age, who had extraordinary difficulties in making water, and an inconveniency even beyond that; namely, that he could not ſit in an ordinary chair, without ſuffering exceedingly in the region of the *peritonæum*.

With the help of lenient ſoft medicines and waters, the patient voided by the *urethra* a ſtone, which was flat in the middle, and ſmooth, but had five points, like the rowel of a ſpur: The points of the rays were ſharp, but there were no aſperities nor cryſtallizations on their ſurfaces: The ſtone was ſmall, ſo as after many days to paſs along the *urethra*: But had it not paſſed thro' the neck of the bladder, but remain'd therein, it would, in all probability have attracted matter to all the points or rays, and increaſed in all dimenſions.

It is very common, that when any extraneous ſolid ſubſtance gets into the bladder, there is either attracted to it, or there adheres to and ſurrounds it, a tartareous calculous concretion, which aſſumes the figure of the ſaid body now in its centre, as a *nucleus*.

There was a ſoldier cut in St. *Thomas's Hoſpital*, *London*, for the ſtone, which, when extracted, was found to cover a muſket-bullet, that had been ſhot into his bladder, where it was cover'd by a calculous concretion.

A gentlewoman thinking with a ſilver bodkin to thruſt back a ſtone that was engaged in the neck of her bladder, it ſlipped into it, and the calculous matter gather'd on the larger end into a ſtone of an oblong figure and equal thickneſs, half an inch all round the bodkin.

A common pin, which by ſome means or other had got into the bladder of a young woman, was there coated all over by a calculous matter; but having occaſion'd a fiſtulous ulcer in her groin, it was diſcharged thence with the matter of the *fiſtula*.

It is in this manner that bezoars are formed: For, the Dr. has the common *Eaſt-India* bezoars, which are roundiſh, and have in their centres the ſeeds of a ſort of *acacia*, which had attracted, or was coated over by that ſubſtance, eſteemed a great cordial or alexipharmic; while others are long, and gather'd in layers or coats upon the ſtalks of vegetables: And he has one formed round the ſtone of that great plumb, which comes pickled from thence, and call'd *mango*.

As to the aſperities or prickles on the rays, they are taken notice of, ſo long ago as the time of *Cornelius Celſus*, who *lib.* VII. *c.* 26. calls them *calculi ſpinoſi*.

It

It may seem very strange and paradoxical, that the fewer thy knobs, asperities or prickles are on the surface of *calculi*, the more troublesome they are to the persons in whose bladders the lie.

Dr. *Hickes* was greatly tormented with the stone in his bladder, especially upon any motion. He would not, on account of his age and several other reasons, submit to be cut for the distemper; but order'd his executors that he should be open'd after his death, and the stone taken out of his bladder, put into a silver box, and given Sir *Hans Sloane* to be placed in his collection of such kind of curiosities. What is very particular in this stone is, that the protuberances and prickles upon it were few, and at a distance from each other: Every one of them had made a hole in his bladder, like a sheath or socket; and when upon motion they were remov'd out of their corresponding sheath, they hurt the bladder in the sound parts, and put him upon the rack.

When the prickles are thick-set, one hinders the other from entering or wounding so deep; and probably, does not get much farther than the *mucus* which lines the inside of the bladder.

Some Oil of Sassafras *crystalliz'd; by Mr.* Maud. Phil. Trans. N° 450. p. 378.

MR. *Maud* observ'd the following uncommon phenomenon in chemistry, namely that some essential oil of sassafras, which had stood expos'd to a frosty night in an open vessel, was changed, three parts out of four, into very beautiful transparent crystals, three or four inches in length, half an inch in thickness, and of an hexagonal form.

These crystals subsided in water, were indissoluble in it, inflammable in the fire, and when expos'd thereto melted into their pristine state.

Hence it is evident, that they still retain the natural qualities of an oil, tho' they appear under a different modification of their constituent parts.

What is most remarkable herein is a transmutation from a fluid to a solid body, of such a particular figure, and from a yellowish liquor, not unlike *Madera* wine, to a very pellucid body, like ice, congeal'd from the most transparent water.

This seems to afford a new instance of crystallization, which being generally accounted for by the particles of a fluid, or those of any other body, suspended by the fluid, brought nearer by

by cold; and at length coming within the ſphere of each others attraction, unite together into an immediate contact.

This oil being one of the heavieſt oils, and even heavier than water, is the more likely thus to unite, as its parts are nearer to one another.

This may be a hint to the curious, to diſcover wherein conſiſts the difference of ſolidity and fluidity; and likewiſe ſhews how much the colour of bodies depends on the mechanical ſituation of their parts.

In *Phil. Tranſ*, N° 389. and 431 Dr. *Neuman* gives an account of a like cryſtallization from thyme, which he calls *camphora thymi*.

An extraordinary Damp in a Well *in the* Iſle *of* Wight; *by Mr.* Benjamin Cooke. Phil. Tranſ. N° 450. p. 379.

IN *June* 1733, a farmer, in hopes of finding a perpetual ſpring of good water, ſunk a well, whoſe diameter was ſeven to the depth of 45 feet (thro' a ſoil, whoſe ſurface was a kind of brick earth, mixt with ſand, which in deſcending became almoſt entirely hard coarſe yellow ſand) which work employ'd the labourers about 20 days, without finding the leaſt appearance of water.

At the diſtance of about 18 foot from the top, a *ſtratum* of a mineral mixture, about 9 inches thick, was dug thorough, without any inconveniency; nor were the workmen in the leaſt incommoded in carrying on the work, till about the 12th day after, when towards the evening they were much annoy'd with a faint ſuffocating heat, (which they compar'd to that coming from the mouth of an oven) and which, as they were drawn up, was moſt remarkably perceiv'd, when they came over againſt the mineral *ſtratum* abovementioned, to come out in the form of a warm ſulphureous *halitus*.

The next morning, a luſty young man attempted to go down (hand over hand, as they call it) by means of a ſingle rope which was uſed to draw up the earth dug up: But as ſoon as he came over againſt the above-mentioned *ſtratum*, he became incapable of ſuſtaining his own weight, fell down to the bottom, and died immediately.

Another young man, not ſuſpecting the cauſe, had the rope nimbly drawn up, and having ſeated himſelf aſtride a croſs ſtick, fixt to the rope for that purpoſe, was haſtily let down to his friend's aſſiſtance: But when he came to the ſame diſtance from the top, he was obſerv'd to give the rope a very great ſhock;

ſhock; and when he came to the bottom, fell down, as the other had done before him, was ſeized with violent convulſions, which held him more than a quarter of an hour, and then he expired.

A third perſon in hopes of fetching up this ſecond before he was quite dead, was tied faſt into a large baſket, and let down more warily: But when he came to the ſame *ſtratum*, finding his breath going (as he expreſs'd it) he cried out, and was drawn up again; but remain'd in the open air, for the ſpace of near half an hour, pale as dead, panting and ſpeechleſs.

The dead bodies were, within three hours time, drawn up by means of a ſort of tongs, uſed to fetch things up from the bottom of the ſea; but brought ſuch a diſagreeable ſtench in their cloaths with them, as made ſeveral hardy men, who aſſiſted in doing of it, vomit.

The next day a cat was let down, and at the ſame place ſeized with convulſions: But being drawn quickly up again, ſoon came to herſelf; which experiment was repeated ſeveral times for ſome weeks following; whereby it was found, that this deſtructive vapour was ſometimes of a greater, and ſometimes leſſer force, and at other times quite gone; ſo that the cat felt no uneaſineſs: And a lighted candle, which would ſometimes be immediately extinguiſhed, as ſoon as it ſunk below this deadly *ſtratum*, would burn clearly at the very bottom.

It was very remarkable, that there was a whitiſh fog in the well, ſo thick that one could but juſt ſee the dead bodies through it.

Water being ſcarce in that place, the well was left open for about eight months, in hopes the damp might at length entirely leave it; but inſtead of that, it became worſe; and not confining itſelf within its firſt bounds, it overflow'd at the top; where when the air was moiſt, it appear'd like a thin white fog; and when the air was dry, could be perceiv'd like a warm breath, at all times diffuſing a ſulphureous ſtench (ſomething like that which ariſes from filings of iron while corroding with vinegar) affecting thoſe who came into it with a giddineſs, ſhortneſs of breath, and propenſity to vomit: So that at laſt the well was fill'd up, being troubleſome to the family which liv'd near it.

The above-mentioned *ſtratum* is continued to the neighbouring clift; where when heated with the ſummer's ſun, it gives a noiſome ſulphureous ſtench; and, after moderate rains, is covered

with

with a yellowish efflorescent salt, very astringent and acid. On the shore below are gather'd *pyrites*

By a letter afterwards from Mr. *Cooke*, he says, that the vein which was cut through the middle of the well, from whence were emitted the fatal effluvia, is a crude ore made up of iron, sulphur, and acid salts, mixt with *pyrites*.

These effluvia were not perceiv'd till after the vein had imbib'd the air for several days.

Whilst the air continued dry, these effluvia subsided, and lay in the lower part of the well, which seem'd fill'd near to an exact level with the *stratum* from whence they came.

But when the weather became rainy, the quantity as well as the *impetus* of the effluvia increased to such a degree, as to appear in mornings over the top of the well, in the form of a mist, and gave great annoyance to those that came within its sphere of activity.

From hence it is worth observing, that the same damp, according to the variation of the weather, is specifically heavier or lighter than the air.

Concerning Magnets *having more* Poles *than two; by Mr.* John Eames. Phil. Trans. N° 450. p. 383.

THE sagacious Dr. *Halley*, in his account of the changes of the variation of the magnetical needle, upon the hypothesis of the earth's being one great magnet having four magnetical poles, tells us, that he had found two difficulties not easy to surmount; the one was, that no magnet he had ever seen or heard of, had more than two opposite poles: Whereas the earth had visibly four, if not more, &c.

In looking over the copy of the journal-book of the *Royal Society*, Vol. II. Mr. *Eames* finds the following article.

'*July* 20, 1664. Mr. *Ball* produced several loadstones, and 'among them two *terrella*'s, one of which seem'd to have four 'poles, with a circle passing between them, of no virtue at all. 'Some of the company suggested, that it was probable this 'stone consisted of two stones, by nature cemented together 'by a piece that had no magnetical quality in it.'

Qu. Whether this stone can be come at, to examine whether it be a single or a double stone?

An

An Account of some Magnetical Experiments; by Dr. Desaguliers. Phil. Transf. N° 450. p. 314.

IN 1715, trying some experiments on a very large weak loadstone, Dr. *Desaguliers* found that it had several poles: Then he tried several other loadstones, and often found four poles in such as had been armed, when he took off their armour.

In large coarse stones he found sometimes eight, nine or ten poles: This made him believe all loadstones to have several poles: But when he tried My Lord *Paisley*'s loadstones, and other very good ones, he then found that homogeneous loadstones had but two poles; those that have more being only an aggregate of magnetical and other matter, which makes an heterogeneous substance. Such is the *Society*'s great loadstone: For, it has several poles.

On the 24th of *June* 1736, the Dr. made the following experiment, before the *Royal Society*.

He took a bar of iron, of one fourth of an inch in diameter (which having stood for 15 years in an erect position, had acquir'd a fixt pole at top: So that the end, which had stood uppermost, attracted the north end of a compass needle, and the other end the south end of the needle) and having suspended it by a string for the space of half a year, it acquir'd a fixt south pole at that end, as well as it had done at the other in 15 years time, without diminishing the virtue of the other end; So that both ends of the rod in any situation attracted the north end of the compass-needle.

That rods of iron untouch'd, or which have not acquir'd a magnetic virtue by their situation, will with their upper end (whatever end of the bar be held upwards) attract the north end of the needle; and the lower end of the bar the south end of the needle, is a truth known many years ago, and mentioned in Dr. *Brown*'s book of *Vulgar errors.*

Some farther Magnetical Experiments made before the Royal Society April 21, 1737; *by the Same.* Phil. Transf. N° 450. p. 386.

IT is well known, and has been often found by experience, that an iron bar, untouch'd by a loadstone, will, with its upper end, attract the north end of a compass needle, when the said bar is held upright, and the south end of the needle with its lower end, when applied to it, still in a perpendicular position, whatever end of the bar be held upwards; unless the

bar has acquir'd a fixt pole by having been long in a vertical position. But if the bar be brought from a vertical to an horizontal position, the needle will return into the situation it had before, which was in the magnetical meridian, the bar being then at right angles to it. Upon raising or sinking the end of the bar which is farthest from the needle, the one or the other end of the needle will begin to move towards the bar: Such a bar has in itself no fixt magnetic virtue; but if it had, it must be heated red-hot, and then cool'd in an horizontal position: A bar thus prepared is fit to make the following experiments, communicated to the Dr. by M. *Du Fay*.

Hold the bar upright, and give it a blow or two against the ground with its lower end; and that end will attract the south end of the needle, when the bar is held horizontal, and at right angles to the magnetic meridian: The other end, held horizontal in the same manner, will attract the north end of the needle. Invert the bar, and its virtue will be lost by striking as many blows with it against the ground with the other end: Then strike another blow or two; and the end, which attracted the north end of the needle, will now attract the south end; and so *vice versâ*, the position being still horizontal.

If the blow be given against the ceiling, or any horizontal body, with the upper end of the bar, the same virtue will be communicated as before.

This will likewise happen, if the upper or lower end of the bar be struck with a hammer or mallet; whether the blow be given end-wise, or at right angles to the bar: Nay, tho' it should be given in the middle of the bar, the position of the bar at receiving the blow being all that is requisite: For, if you give the bar only a jerk or shake in that vertical position, it will receive the virtue, as if there were in the iron several threads, or beards, fixt at one end, as M. *Du Fay* supposes, which the blow or shake laid all one way, and which were placed the other way by inverting the bar; and then giving it a shake or blow.

N. B. When the bar is placed horizontally, a blow in the middle destroys its virtue.

An

An antique Metal Stamp in the Duke of Richmond's *Collection, being one of the Instances how near the* Romans *had arriv'd to the Art of* Printing; *with some Remarks by Dr.* Mortimer. Phil. Transf. N° 450, p. 388. 1738

SINCE arts and sciences, especially statuary and sculpture, were arriv'd at so great perfection, when the *Roman* empire was in its glory; as the many beautiful statues, the exquisite *intaglia*'s, and fine medals, which time hath handed down to us, do sufficiently evince: It is very surprising, that they never hit on the method of printing books.

The dies they made for their coins, and their stamping them on the metal, was in reality printing on metal; their seals cut in cornelians and agates, and their stamping them on dough and soft wax, was another sort of printing; and a third sort was the marking their earthen vessels, while the clay was soft with the name of the potter, or the owner the vessel was made for. These being of a larger size were properly call'd *signa*; the seals cut in stone were call'd *sigilla*, being a diminutive of *signum*: But the later and more barbarous *Latinists* have formed the diminutive of *signum* into *signetum*; and if a very small pocket seal, they have call'd it *signaculum*. Vide *Joh. Mich. Heinecius de sigillis. Francof.* 1709 fol. p. 16 *& seq.*

The learned *Montfaucon*, amongst his prodigious treasures of antiquities, in his *Antiquité expliquée* Tom. III. Part 2, ch. 12. gives us the figures and descriptions of several of these larger *sigilla*, or *signa*, on which, *says he*, the names were all cut in *creux*, in capital letters; he imagines their use to have been to mark earthen vessels, particularly those large earthen jars, wherein the *Romans* used to keep their wines.

If any of them had occurr'd to him with the letters *excisæ*, *exculptæ*, protuberant or standing out, as the types in our modern way of printing are made, so accurate a describer of antiquities could not have pass'd such a one over without taking notice of it; and that the rather because of its being a greater rarity: Tho' several lamps of *terra cotta* are stamp'd with letters impress'd or hollow, from such protuberant letters as in Fig. 5. Plate XII. but the greater number have the letters rais'd or standing out.

The said Fig. represents one of that sort of stamps, whereon the letters are *exsculptæ* or protuberant; as is likewise the edge or border round the whole stamp.

This

This ſtamp is made of the true ancient braſs, and is cover'd over with a green ſcale or coat, ſuch as is uſually ſeen on ancient medals. It was found in or near *Rome*. On the back is faſtened a ring, the hole whereof is $\frac{21}{40}$ of an *Engliſh* inch one way, and $\frac{22}{40}$ the other way: The plate itſelf is two inches long, wanting $\frac{1}{40}$, and its breadth exactly $\frac{32}{40}$ of an inch: The ſides are parallel to one another, and the ends are likewiſe parallel to each other; but they are not upon an exact ſquare with the ſides, varying about one degree and a half from an exact rectangle. On the under ſide ſtand two lines or rows of letters $\frac{7}{40}$ of an inch in height, and well formed *Roman* capitals: The faces of them ſtand up all upon an exact level with one another, and with the edge or border of the ſtamp; their protuberance or height above the ground is different, the ground being cut uneven: For, cloſe to moſt of the letters, the ground is cut away only $\frac{2}{40}$; cloſe to ſome, near $\frac{3}{40}$, and cloſe to the edges, full $\frac{3}{40}$.

The firſt line of the figure contains the following letters C I C A E C I L I ᵥ, with a ſtop or leaf to fill up the line; in the ſecond line H E R M I A E. S N. which the Dr. judges is to be read *Caii Julii Cæcili Hermiæ Signum.*

Who this *Caius Julius Cæcili s* was, the Dr. cannot find, he being probably a man in a private ſtation; and ſo his name hath not been handed down to us in any monuments, but only accidentally in this ſtamp.

In *Gruter* occur two of the name of *Hermias*, and ſeveral of the *Cæcilii*, but none with theſe two names joined together.

The uſe of this ſtamp ſeems to have been for the ſignature of the above-mentioned private man, to ſave him the trouble of writing his name, as ſome people have now adays. It was certainly uſed on paper or membranes, being firſt dipt into ink, or ſome ſort of paint, becauſe of the protuberance of the letters; the hollow letters being fitter for ſoft ſubſtances, on which they leave the impreſſion ſtanding up, and conſequently more legible.

Another argument, that this ſtamp was not to be uſed on any ſoft ſubſtance into which it might be preſs'd quite down to the ground, is the unevenneſs or roughneſs with which the ground is finiſh'd; which, was it to have made part of the impreſſion, the workman would have finiſh'd with more accuracy; but he knowing that the ſurface of the letters was to perform the whole work requir'd, was only attentive to finiſh them with that accurate evenneſs that theſe have.

The

The learned M. *Mattaire*, in his *Annales typographici Hagæ*, 1719 in 4*to* p. 4, concludes from the best authors, that our modern art of printing was first thought of about 1440, a copy of the book he mentions *ibid. p.* 13, call'd *speculum nostræ salutis*, being pictures of stories out of the bible, with verses underneath in *Dutch*, which the Dr. has seen in the *Stadt-house* at *Harlem*: Each page was printed from a block of wood, like a sorry wooden cut: And this was the first essay of printing, which hint was taken from engraving, and is what he means p. 4. by *typi fixi*: After which they soon improv'd to use separate types, as we now do, which he terms *ibid. typi mobiles*.

This stamp is in reality a small frame of fixt types, and prints with our modern printers ink, which is only a sort of black paint, as readily as any set of letters, cut in the rude manner these are, can be expected to perform: The Dr. has, therefore, given the figure of it, as the most ancient sample of printing known of: For, by the appearance of the metal it seems to be of the upper empire.

By this stamp it appears, that the very essence of printing was known to the *Romans*; and they had nothing to do but to have made a stamp with lines three or four times as long, and containing twenty instead of two lines, to have formed a frame of types, that would have printed a whole page, as well as *Coster's* wooden blocks, which he used in printing the *speculum salutis*.

In the first volume of a collection of several pieces of Mr. *John Toland*, printed *London* 1726, 8vo. p. 297. is a small tract of his, intitul'd *Conjectura verosimilis de prima typographiæ inventione*, which is founded upon the following passage in *Cicero cap.* 20. *lib.* ii. *de natura deorum*; where *Balbus* the stoic uses the following words in an argument against *Velleius* an *Epicurean*.

'Hic ego non mirer esse aliquem, qui sibi persuadeat, corpora quædam solida atque individua vi & gravitate ferri; mundumque effici ornatissimum & pulcherrimum, ex eorum concursione fortuita? Hoc qui existimet fieri potuisse, non intelligo cur non idem putet, si innumerabiles unius & viginti formæ literarum (vel aureæ vel quales libet) aliquo conjiciantur; posse ex his in terram excussis annales Ennii, ut deinceps legi possint, effici; quod nescio anne in uno quidem versu possit tantum valere fortuna.'

He conjectures that this very passage gave the first hint to the inventors of printing about the year 1445; because they retain'd

retain'd even *Cicero*'s name for their types, calling them *formæ literarum*, and made them of metal, as he ſays, *aureæ vel quales libet*. Moreover in cap. 10. lib. III. *de Divinatione*, *Cicero* hath the very phraſe *imprimere literas*.

Brands for marking cattle were in uſe in *Virgil*'s time, *Georg. lib.* III. *ver.* 158, where he ſays,

Continuoque notas, & nomina gentis inurunt.

Procopius in his *Hiſt. Arcana* ſays, that the Emperor *Juſtinus*, not being able to write his name, had a thin ſmooth piece of board, thro' which were cut holes in form of the four letters repreſented in Fig. 6. Plate XII. which, laid on the paper, ſerv'd to direct the point of his pen, which being dipt in red ink, and put in his hand, it was directed by another.

Poſſibly this may likewiſe have given the hint to the firſt of our card-makers, who paint their cards in the ſame manner, by plates of pewter or copper, or only paſt-boards, with ſlits in them in form of the figures that are to be painted on the cards.

An Occultation of Mercury *by* Venus May 17, 1737 *at the* Royal Obſervatory *at* Greenwich; *by Dr.* Bevis. Phil. Tranſ. N° 450. p. 394. *Tranſlated from the* Latin.

App. Time p. m.			
H.	M.	S.	
1	37	3	The preceding limb of *Venus* paſſes the meridian, the centre being 25° 46′ 35″ diſtant from the vertex.
			But the Dr. did not at all ſee *Mercury* in the teleſcope.
	4	9	The centre of *Mercury* preceded the preceding limb of *Venus* 12″ of time.
	6	20	The obſervation repeated, when the centre preceded the ſame time as before.
	28	0	*Mercury* running along the parallel thread of the micrometer, the ſouthern cuſp of *Venus* was cut by the ſaid thread (Fig. 7. Plate XII.) whence the Dr. gather'd that *Venus* would cover *Mercury* or at leaſt juſt touch him: He, therefore, remov'd the micrometer, the better to obſerve the approaching contact with a teleſcope of 24 foot.

App

App. Time p. m.			
H.	M.	S.	
9	43	4	*Mercury* is but the tenth or twelfth part of *Venus*'s diameter distant from her: Afterwards clouds intercepted the view.
	51	10	*Venus* shone out again very bright; and *Mercury* was entirely hid under her: Now clouds again cover *Venus*, and intercept the view of so uncommon a sight.

May 18. P. M.

The meridian distance of the sun from the vertex was 30° 4′.

1	31	53	The preceeding limb of *Venus* passes the meridian. The centre distant from the *vertex* 25° 57′ 15″.

The Dr. could neither this day see *Mercury* culminate, tho' the sky was very serene.

N. B. The distances from the vertex are not free from refractions.

A new azimuth Compass *for finding the Variation of the* Compass-needle, *at Sea, with greater ease and exactness than by any hitherto contriv'd for that purpose*; *by* Capt. Christopher Middleton. Phil. Trans. N° 450. p. 395.

TO discover the declination of the magnetic needle, or variation of the compass at sea, with some tolerable degree of certainty and exactness, is a thing of great use and importance in navigation.

The instruments and methods hitherto made use of for this purpose (as might easily be demonstrated) are subject to several inconveniencies, errors and defects: To remedy which, this new azimuth compass was contriv'd, and has by experience been found effectual. It would be needless to give a description of the instrument, the Capt. therefore, only shews the manner of using it, which is, as follows.

1. The instrument must be rectified, or fitted for observation, by turning it about till the 4 cardinal points, that are suspended upon the centre-pin, agree with the 4 cardinal points on the chart, at the bottom of the box: Then will the needle, that shews the magnetic meridian, stand at no degrees; and the east and west points at 90 degrees, on the graduated circle within the

the box: And in this situation it must be kept, as near as may be, during the whole time of the observation.

2. Let the index of the quadrant be placed to that degree of the arch, on the rim of the box, which the observer judges to be nearly equal to the height of the sun, or star, whose azimuth is sought: For, by this means the object will be more readily found.

3. Turn the quadrant round towards the sun or star, till it appear upon the vertical hair within the telescope, to an eye looking thorough the small hole or sight; and then slide the index a little upwards or downwards on the arch, till the object be brought by this means to coincide or touch the visible horizon.

Lastly, the degrees and minutes then markt by the index upon the arch of the quadrant, will shew the altitude of the object, which will always be the same, whether the instrument is in motion or at rest; at the same time the degree cut by the index on the horizontal rim or circumference of the compass-box, will give the magnetical azimuth of the sun or star.

N. B. All this may be performed by one person: Whereas the old compass requires several to manage it; which likewise makes it subject to several considerable errors.

How the variation of the needle is found by means of magnetical azimuth and altitude thus obtain'd, is taught in every treatise of navigation: But as the resolution of this problem is somewhat troublesome, and requires such a knowledge of the doctrine of the sphere, as every seaman has not attain'd, the Capt. here exhibits an easy method of discovering the variation of the compass without any manner of calculation.

1. Let the magnetic azimuth of the sun (or any star, when it is near the prime vertical, and considerably elevated above the horizon) be found according to the directions already given, before it arrive at the meridian; and note well the altitude, or let the index remain fixt at the same point on the arch.

2. Find the magnetic azimuth of the sun or star in like manner as before, when it is exactly at the same degree of altitude, after it has pass'd the meridian: And

3. If these two magnetical azimuths are equal, the needle has no variation; if unequal, add them together, and half the sum will be the true azimuth; or substract the less from the greater, and half the difference will be the variation requir'd. The circumstances of the observation will the more readily discover, whether the declination is easterly or westerly.

N. B.

N. B. Tho' it would be very commendable in such as use the sea, to learn the names of most of the principal fix'd stars; yet even that knowledge is not necessary in the use of this instrument: Nor is it needful in this case to know exactly the latitude of the place of observation, provided the difference of latitude between the observations be not very great. It is sufficient that care be taken to observe the same star, before it comes to the meridian, and after it has pass'd it: And for the sake of greater exactness, the above caution should be regarded, to wit, that the star be at some considerable height above the horizon, and likewise near the prime vertical.

The Number of People in Holland *and* West-Friesland, *as also in* Harlem, Gouda *and the* Hague, *drawn from the Bills of Births, Burials, or Marriages in those Places; by M.* Kersseboom. Phil. Transf. N° 450. p. 401.

EVERY body knows to what useful purposes the bills of births and burials at the City of *Breslau*, the Capital of *Silesia*, have been applied by Dr. *Halley*; as also what curious observations both moral, physical and political have been made by Sir *William Petty* upon the same argument, several years before and by Dr. *Arbuthnot* and others since. M. *Kersseboom* hath not only consulted them, but acquainted himself more particularly with Mr. *King*'s observations in *Davenant*'s essays, &c. in order to render himself more capable of making a just estimate in this matter.

He begins with the number of inhabitants in the two provinces of *Holland* and *West-Friesland*; these he makes at this time, *viz.* in 1738, to amount in all to 980,000, and presents the reader with the following table of the particulars.

It exhibits the number of people of all ages, living at the same time, from the birth to extreme old age; which because it shews the chances of mortality within the ages mention'd, he calls the table of contingency of life and death.

The table of contingency

Of above 90 years of age there are		500
90 to 86 inclusive		2,500
85 to 81		6,500
80 to 76		13,000
75 to 71		20,300
70 to 66		27,300
65 to 61		34,300
60 to 56		40,800
55 to 51		47,000
50 to 46		53,000
45 to 41		57,800
40 to 36		62,500
35 to 31		67,600
30 to 27		58,400
	The sum above 27 years	491,500
Of 26 to 21		94,300
20 to 16		83,400
15 to 11		87,200
10 to 6		91,800
5 to birth		131,800
	Sum under 27 years of age	488,500
		491,500
		488,500
	Sum of all the inhabitants	980,000

This table is founded upon three principles, *viz.* correct obſervations upon the tables of aſſignable annuities in *Holland*, which have been kept there upwards of 125 years; wherein the ages of the perſons dying are truly enter'd: Upon a ſuppoſition that there are yearly born in the two provinces 28.000 living children; and laſtly, that the entire number of inhabitants in any country is to the number of the births as 35 to 1.

This table was ſent ſome time after its compoſure to Profeſſor *S Graveſande* to know his thoughts, as well concerning its juſtneſs, as its fitneſs to aſcertain the value of annuities on lives; and it met with his approbation.

From

From this table it appears

1. That about half the number of people in the two provinces are above 27 years of age, and consequently that near the other half are under that age.

2. Then by following what hath been obferv'd for more than 100 years in *England*, and particularly in *London*, out of 35 children born, 18 of them are boys, and 17 girls, the people in these two provinces will consist of

504,000	Males.
476,000	Females.
980,000	

He farther remarks, that it appears from the affignable annuities for lives mentioned before, the females have in all accidents of age liv'd about three or four years longer than the fame number of males; which he looks upon to be appointed as a compenfation for the continual excefs there is in the birth of the males above that of the females.

Having confidered the quantity, he then comes to take notice of the quality of thefe 980,000 inhabitants, and fays he fees no reafon to differ from the proportion of Mr. *King* in *Davenant*'s effays, who with a great deal of pains and judgment hath divided the people of *England* in the following manner.

The proportion for every 100,000 inhabitants is

Married men and women	34,500
Widowers	1,500
Unmarried young men and children	45,000
Servants	10,500
Travellers, ftrangers, &c.	4,000
	100,000

If this proportion be admitted, then the number of each fort in *Holland* and *Weft-Friefland* will be as underneath.

M. *Kerffeboom* adds that the faid provinces can raife at this time 220,000 able bodied men, deducting one tenth for difeafes and other infirmities: But then he admits perfons at 16 years of age; whereas Dr. *Halley* admits none till 18; per-

ſons under that age being generally too weak to bear the fatigues of war, and the weight of arms.

He then proceeds to rectify the miſtakes of the learned *Iſaac Voſſius*, who makes but 550,000 in *Holland*, *Weſt-Frieſland*, &c. Diſallows Sir *William Petty*'s account of the number of people in *London*; becauſe he makes them alone equal to the inhabitants of *Holland* and *Weſt-Frieſland* together.

He cloſes the whole with a table of the preſent value of annuities upon lives, in proportion to the ordinary or common bonds, charged upon theſe provinces, and ſubject to the extraordinary taxes rais'd at this time, *viz.* 1738.

Hereto is annex'd the degrees of mortality or fatality ſaid to be in the *Hague* and *Haagambagt*, as alſo the numbers and conditions of the inhabitants of *Amſterdam*, *Harlem*, *Gouda*, and the *Hague*, not omitting *London* at this preſent time.

	The two provinces of *Holland* & *Weſt-Frieſ.*	*Amſter-dam*	*Har-lem.*	*Gouda.*	*Hague*	*London*
Married men and women	338000	86156	17420	6900	14850	241800
Widowers	14700	4218	760	300	720	13100
Widows	44100	13858	2280	900	2380	45700
Unmar. youth and children.	441000	93990	22700	9000	16190	215700
Servants	102900	28318	5300	2100	4870	85000
Travellers ſtrangers, &c.	39300	14460	2040	800	2490	52300
Total	980000	241000	50500	20000	41500	653600

The fatality of the quarters.	Dead.
Spring to ſummer	307
Summer to the autumnal equinox	286
Autumn to winter	287
Winter to ſpring	286

The

The fatality of the months 31 years, one with another.

	Dead.
January	102
February	88
March	95
April	77
May	112
June	100
July	92
August	95
September	99
October	93
November	95
December	99

Hence it appears that *March* is leſs fatal at the *Hague* and *Haagambagt* than *April*; and *April* than *May* and *June*; that *May* is the moſt fatal month of all; that the remaining months are nearly equal.

It appears farther, that three parts or ſeaſons of the year are very nearly equal; but that the other quarter or ſeaſon, beginning at the vernal equinox, is more fatal than any of the reſt by one fifteenth part.

Table of annuities for life.

Let the annuity be 100 guilders a year, upon a life under a year old.

		Guild.		Guild.	Stiv.	
Its preſent value is		1667	that is	6	0	*p. cent.*
Upon a life of 5 years to	1 inclusive	1869		5	7	
10	6	1835		5	9	
15	11	1770		5	13	
20	16	1667		6	0	
25	21	1587		6	6	
30	26	1515		6	12	
35	31	1429		7	0	
40	36	1334		7	10	
45	41	1212		8	5	
50	46	1093		9	3	
55	51	971		10	6	
60	56	840		11	8	
65	61	709		14	2	
70	66	570		17	11	

Uſe

USE.

Question. Let it be desired to know the present value of any annuity for life, for instance, of 90 guilders a year, which was granted in the year 1703, upon a life then of three years old.

Answer. The life now in 1738 is between 37 and 38 years old: Hence the number between 40 and 36 gives 1334 for the present value of an annuity of 100 guilders: Hence $\frac{1334 \times 90}{100} = 1200$ guilders is the present value of the annuity for that life.

As to that part which treats of the number of inhabitants of *London* Mr. *Maitland* makes the following remarks.

M. *Kersseboom* asserts that the city of *Paris* in 1684, and at the close of the last century, contain'd more inhabitants than the city of *London*.

And to prove that *Paris* contains a greater number of inhabitants than *London*, he has had recourse to the accounts of christenings annually publish'd in both cities, without giving himself the trouble to enquire into the nature of those his authorities; which if he had done, he would soon have discover'd, that the former is a perfect account; while the latter is, perhaps, the most defective of any extant: For, the christenings therein mentioned are only those at which the parish clerks are present; which Mr. *Maitland* is of opinion cannot amount to near two thirds of the whole, as he endeavours to make appear.

The burials in the annex'd table, by some typographical errors in Mr. *Maitland's Political Account of his History of London* p. 535, from which it is taken, being increased 491 above the real number in *Graunt*'s account, *Nat.* and *Polit. Observ.* 3d edit. *Lond.* the sum total whereof amounting to 90350, must be reduced to 89859: And as in the annex'd term of years, there appears to have died of the plague 1741 *Maitland*'s *Hist. Lond.* p. 535. three and a half of which, Mr. *Maitland* computes would have died of common distempers, out of each hundred; which amounting to about 61, the same deducted from 89859, the real number of the burials, the sum will be reduced to 89798, which taken from 90883, the total of the christenings, the remaining sum will be 1085, which divided by ten, the medium thereof will be $108\frac{1}{2}$ yearly in favour of the christenings.

A de-

A decenary account of the christenings and burials of *London*, in the following years.

Years.	Christen'd.	Buried. Com. Dist.	Buried Plague.	Totals buried.
1626	6701	7400	134	7534
1627	8408	7713	4	7717
1628	8564	7740	3	7743
1629	9901	8771	0	8771
1630	9315	9228	1317	10545
1631	8524	8288	274	8562
1632	9584	9527	8	9535
1633	9997	8392	0	8392
1634	9855	10899	1	10900
1635	10034	10651	0	10651
To. Gen.	90883	88609	1741	90350

This difference in favour of the christenings is owing to the citizens of that time being almost of the same persuasion: But the civil war breaking out soon after, the people separated into a variety of sects, subverted the Church of *England*, and assuming the civil power, establish'd a new Church Government. But the members of the abolish'd Church continuing to baptize among themselves (without reporting their christenings to the new appointed members of the company of parish-clerks) occasioned a very great defect in the account of christenings, annually publish'd by the said parish-clerks.

From this *epocha* is to be dated the excess of the burials in the bills of mortality over the christenings of *London*. And tho' the Church of *England* was soon after re-establish'd, yet the numerous dissenters of all denominations, presevering in their separation, continued to baptize within themselves, without sending in accounts of their christenings to the restor'd members of the company of parish-clerks: And the schism still continuing, the accounts of the christenings and burials of this city, remain upon the ancient foot of division and imperfection.

Add to this, that not only all the foreign Churches in *London* christen within themselves, but likewise several churches and chappels of the Church of *England*, that do not send in their accounts to the company of parish-clerks; which, together with those of the dissenters and foreigners of all denominations, amount to no less a number than one hundred and eighty one congregations, whose accounts of christenings are

not

not publiſhed. By which it plainly appears, that the vaſt diſparity between the chriſtenings and burials of this city, is not owing, as M. *Kerſſeboom* vainly imagines, to the reſidence of the court, convention of parliament, and great reſort of people from all parts, but in fact to the great defect above mentioned.

However, from the aforeſaid very defective account of the chriſtenings of this city, M. *Kerſſeboom* has calculated the number of its inhabitants by a medium of the chriſtenings in the years 1684 and 1685; whereby he makes the number at that time amount to five hundred thouſand three hundred and fortie four: But as this number is only taken from a medium of two years, he imagines it too great; therefore to reduce the ſame to the number of four hundred and ſixty nine thouſand ſeven hundred, by a medium of twenty years, he has unwarrantably precluded the ſum of fourteen thouſand ſeven hundred and two, the number of chriſtenings in the year 1684, to make room for the ſum of eleven thouſand eight hundred and fifty one, the number of chriſtenings in the year 1674; whereby the number of inhabitants in *London*, is very much leſſened.

And as a farther inſtance of M. *Kerſſeboom*'s partiality in favour of the city of *Paris*, he has calculated the number of its inhabitants (without mentioning the uncertainty of a calculation, founded on a ſhort ſpace of time, as he has done in the caſe of *London*) at a medium of the chriſtenings for the years 1670, 1671 and 1672; whereby, he makes them at that time amount to ſix hundred and ten thouſand three hundred; adding, the number muſt have been greater at the end of the laſt century; as by his extravagant manner of calculation it ſhould be at preſent.

But as it appears by the above ſpecified ten years account, that the chriſtenings of *London* greatly exceed the burials of that time. Mr. *Maitland* thinks it will not be denied, that they exceed the ſame at preſent; eſpecially if we conſider, that the number of chriſtenings in *Paris*, at a medium of nine years (preceding that of 1737) exceeding that of the burials ninety eight yearly; notwithſtanding that city not only abounds with a vaſt number of religious of both ſexes, who are ſworn to celibacy, but likewiſe many thouſand ſtudents belonging to the univerſity, who lead a ſingle life: Whereas in *London* there are no ſuch perſons to prevent the increaſe of its inhabitants.

And as in Mr. *Maitland*'s political account of *London* p. 540. and 548. it appears, that at a medium of nine years, there are annually buried in *London* 29542, and in *Paris* only 17804, which

which is 11738 in favour of the former. So must the births in *London* at present (according to the above-specified ten years account, the reasons aforesaid, and the *Paris* account of christenings) yearly exceed those of *Paris* 12320; whereby is shewn, that the inhabitants of *London* exceed those of *Paris* above three fifths in number.

What M. *Kersseboom*'s partiality in favour of the city of *Paris* is owing to, Mr. *Maitland* does not know, unless it be out of pique to Sir *William Petty* (with whom he seems not well pleas'd) for saying, that the city of *London* contain'd as many inhabitants as the province of *Holland* and *West-Friesland*: Which Mr. *Maitland* thinks will be no difficult matter to make appear, by allowing M. *Kersseboom*'s suppos'd number of 28000 children to be annually born in the said province: Whereas according to the above-specified ten years account, and the *Paris* proportion of births, there must be annually born in *London* thirty one thousand and eight children.

Therefore as this number, according to Mr. *Maitland*'s calculation *Hist. Lond.* p. 541, is the produce of 725903, the present number of the inhabitants of *London*, so must 28000, the number of children suppos'd to be born yearly in the province of *Holland* and *West-Friesland*, be the produce of 655485, the present number of the inhabitants of the said province. Notwithstanding M. *Kersseboom* by his excessive and unprecedented reckoning of the births at a thirty fifth part of the people, has calculated them at 980000. Whereas by the ingenious and learned Dr. *Halley*'s method of calculation (which is so highly approv'd of by M. *Kersseboom*, that he seemingly would be thought to make it the standard of his calculations) the inhabitants of the province of *Holland* and *West-Friesland* do not amount to twenty nine times the number of the births; which gives room to suspect, that M. *Kersseboom* has introduced this unheard of excess, to increase the number of people in the said province of *Holland* and *West-Friesland*.

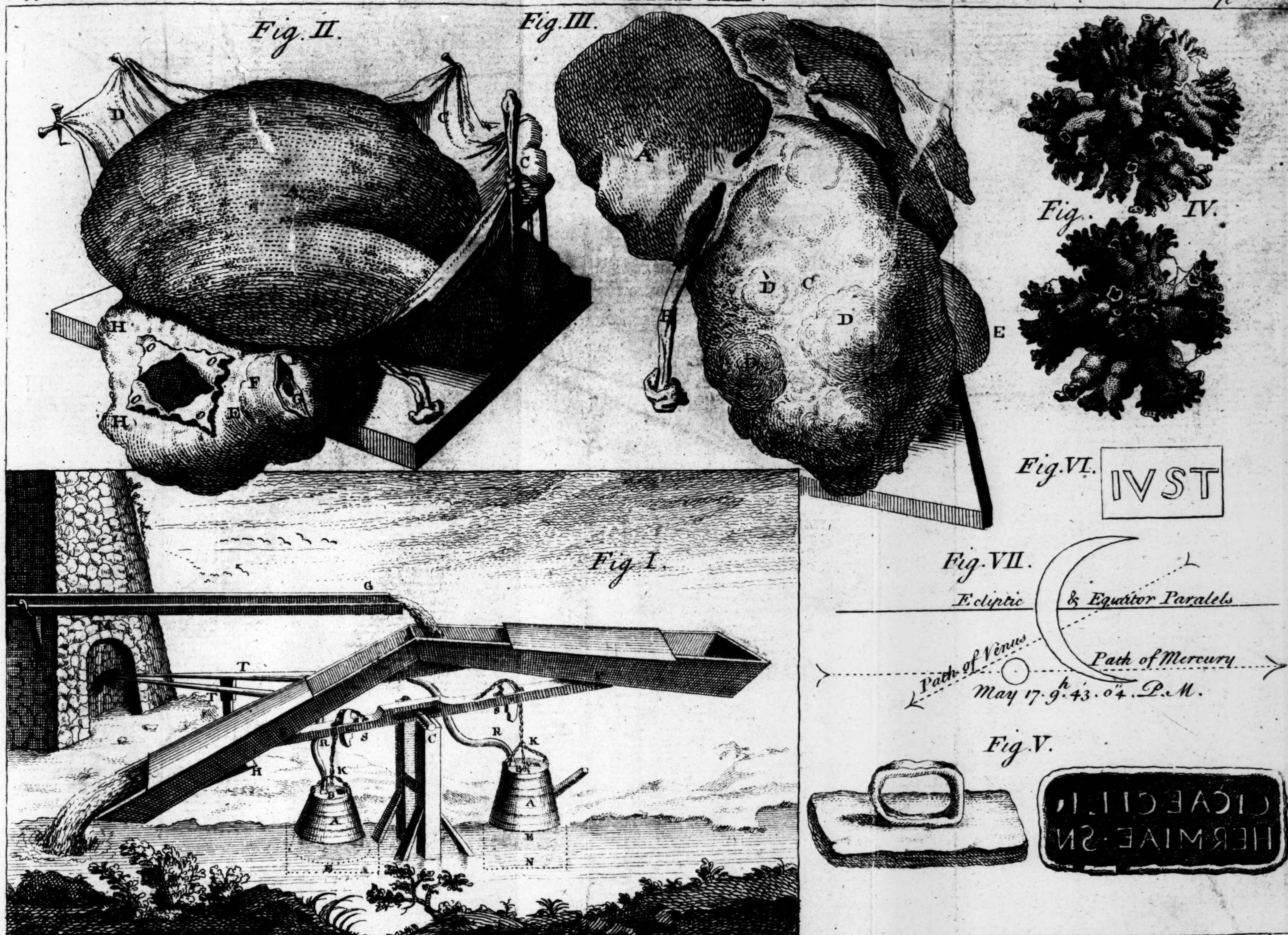
The END *of the* TENTH and LAST VOLUME.

[illegible] [illegible] to [illegible]
[illegible] according to [illegible]
count, the [illegible] [illegible], and [illegible]
[illegible] yearly [illegible] that of [illegible] [illegible] [illegible] that
the inhabitants of *London* exceed those of *Paris* [illegible]
are fifths in [illegible].

With Mr. [illegible] [illegible] partiality in favour of [illegible]
belonging to, Mr. *Maitland* does [illegible] allow, [illegible]
place to Sir *William Petty* (with whom he seems [illegible]
pleas'd) for saying, that the city [illegible] contains [illegible]
inhabitants as [illegible] province of *Holland* and *West-Friesland*,
which Mr. *Maitland* thinks will [illegible] [illegible] so to
appear, by allowing M. [illegible] [illegible] suppos'd number of
children to be annually born in that province, [illegible] ac-
cording to the [illegible] [illegible] account, and the [illegible]
proportion of [illegible] [illegible] annually born in [illegible]
thirty one thousand and [illegible].

Therefore as this number, according to Mr. *Maitland's* calcu-
lation *Hist. Lond.* [illegible] is the produce of a [illegible]
lent number of the inhabitants of [illegible], [illegible]
number of children suppos'd to be born [illegible]
Holland and *West-Friesland*, be the [illegible] of [illegible]
present number of the inhabitants [illegible]
standing M. *Kersseboom* [illegible]
uting of the births [illegible] thirty [illegible]
lead [illegible] [illegible] by the [illegible]
Dr. *Halley's* method of calculation (which [illegible]
of by Mr. *Kersseboom*) that he seemingly would be thought to
make it the standard of his calculations) the inhabitants of the
province of *Holland* and *West-Friesland* do not exceed [illegible]
nine times the number of the [illegible], which gives room to sus-
pect, that M. *Kersseboom* has [illegible] [illegible] [illegible]
enumerate the inhabitants [illegible] the said province of *Holland*
and *West-Friesland*.

The END *of the* FOURTH *and* LAST VOLUME.



G. Smith del. J. Hulett Sculp.

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